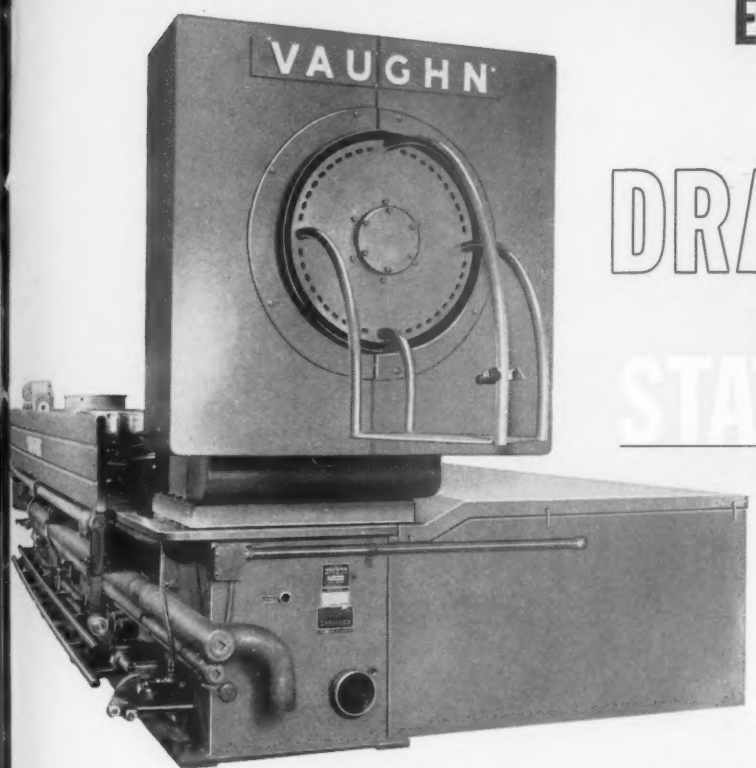
WIRE AND WIRE PRODUCTS

NOVEMBER 1959

On your present Vaughn® Motoblox®...



ENJOY NON-STOP DRAWING (Coil After Coil) **with the VAUGHN STATIONARY BLOCK CONVERSION UNIT**

"Quick on the Draw!"

The increased performance and economy derived from this latest Vaughn innovation make it a profitable investment for Motoblox owners and buyers.

The Vaughn Stationary Block Conversion Unit installs into existing drive and air cooling—enables greater continuity of operation because machine does not have to be stopped to strip bundle—produces heavyweight, densely packed coils of large or small size as desired.

Installation by Vaughn is quickly accomplished. Write for complete details.

The VAUGHN MACHINERY COMPANY CUYAHOGA FALLS, OHIO

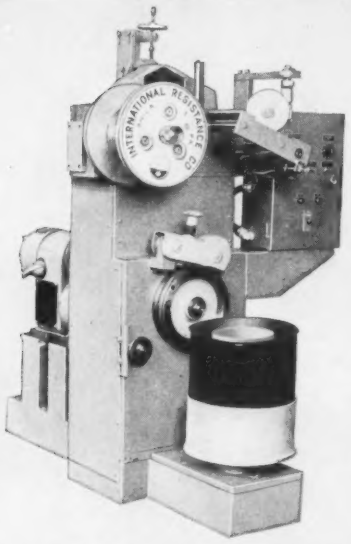
COMPLETE COLD DRAWING EQUIPMENT— Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

COULTER & McKENZIE

CONSTANT TENSION DRAW-PAK EQUIPMENT

FOR CONTINUOUS WIRE PACKING & DRAWING

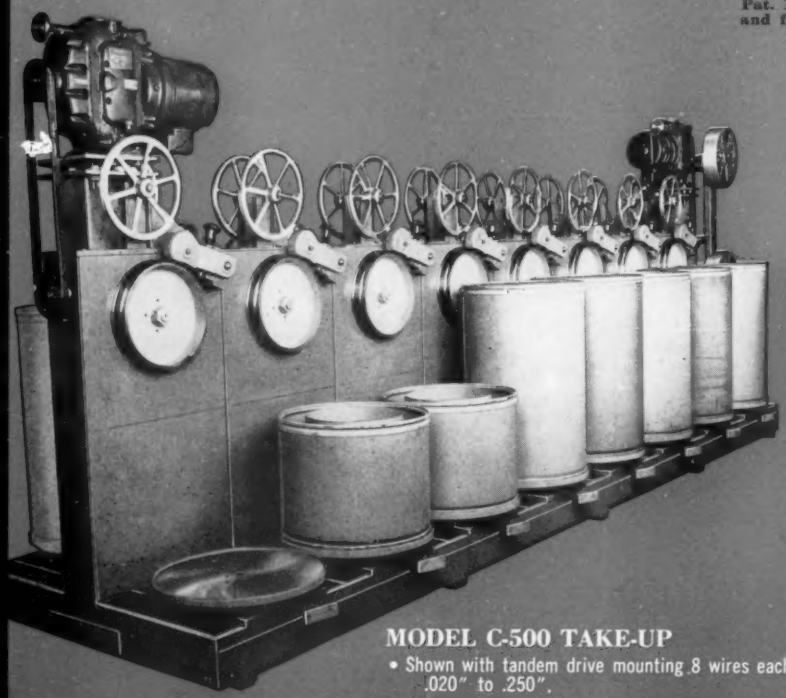


- Combination drum or spool take-up and rewinder.
- Shown for single wire.
- Adjustable for tension, pitch and amplitude of traverse.
- 12" spool shown. 30 to 150 lb. drums.

MODEL C-100 TAKE-UP

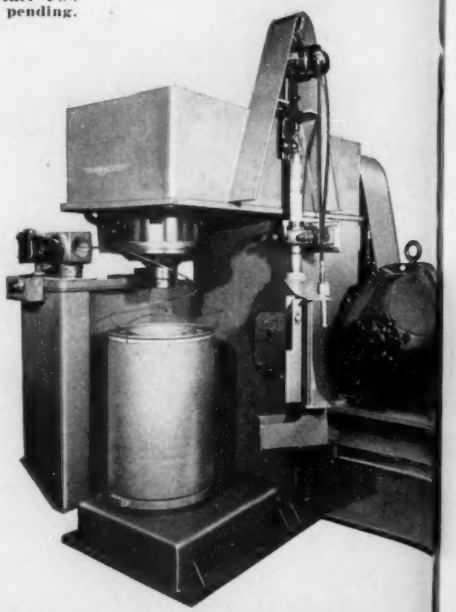
- Shown with single drive mounting to 16 wires .008" to .051"
- Enameling, annealing, galvanizing, tinning, etc.
- Containers 30 to 150 lbs.

Pat. No. 2,732,080. Other U.S. and foreign patents pending.



MODEL C-500 TAKE-UP

- Shown with tandem drive mounting 8 wires each side .020" to .250".
- Galvanizing, patenting, enameling, etc.
- Drum or adapter weights 200 to 1,000 lbs.



MODEL 138-A DRAW BLOCK

- Single draft wires .016" to .375"
- "Draw-cast" die box shown gives adjustable positive cast control. Also available in other sizes.
- Process adapters to order — drums to 1,000 lbs.

Your inquiry specifying the application which is of interest to you will result in prompt and courteous attention.

Barron & Crowther Ltd., Eastleigh, England. European Draw-Pak Licensees Idos Industries Ltd., Royston, Herts, England, Sales Agents.

35 UNION AVENUE

TELEPHONE EDISON 5-1101
LIEBER'S CODE "MACKENZIE"

THE COULTER & McKENZIE MACHINE CO., INC.

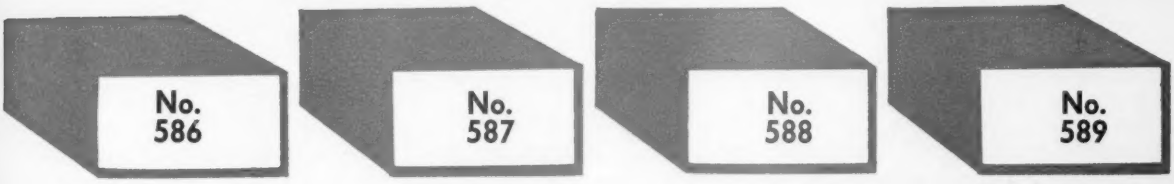
SINCE 1843 BRIDGEPORT 7, CONNECTICUT, U.S.A. INCORPORATED 1881

PRESENTING

THE "580" GROUP • • •

A New Series of "Full Range Lubricants"

"America's Finest Wire Draw"



1. **Designed for practical application in any mill as a General Purpose Lubricant.**
2. **Now in daily use as a Spring and Rope Wire Lubricant.**
3. **Designed to permit substantial "leaning," to meet specific in-plant and customer requirements.**
4. **Mill Tested and Approved for both High and Low Carbon Steel and numerous Ferrous and Non-Ferrous Alloys.**
5. **Our field service representatives are available to review this entire series at your convenience.**
6. **No. 588 is also proving an excellent mat stock lubricant where mechanical descaling of rods is desirable.**
7. **In many cases mills have found the use of one of the 580 series has permitted increased speeds of 100%.**

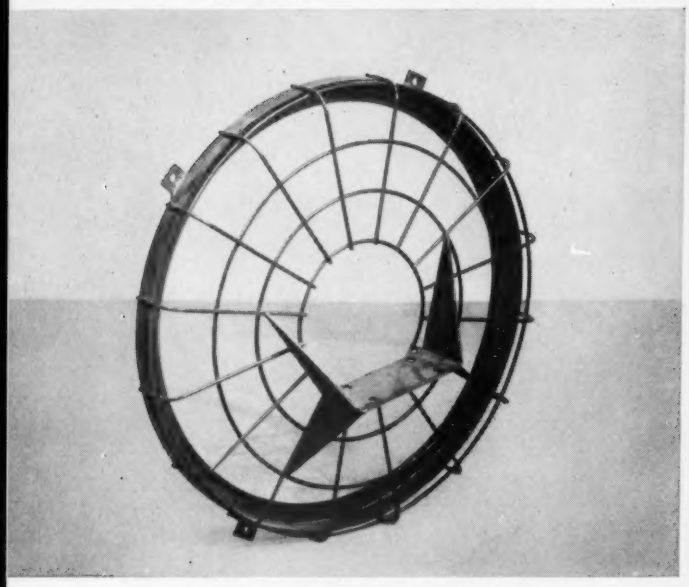
"Look to Standard for the Future"

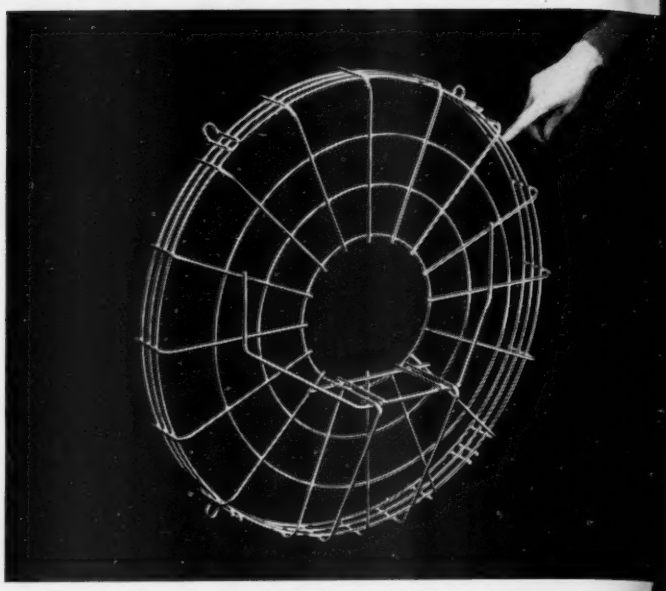
Cordially yours,

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

Standard Industrial
COMPOUNDS CO., INC.
Member WAS

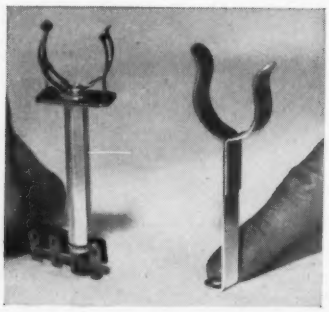
FRANKFORT, ILLINOIS
(A suburban Chicago area city)
Telephones: 2131 - 2141





MOTOR MOUNT AND GUARD for a transformer cooling fan. The all-wire piece, right, reduced cost to one third of former price, and weight from 24 lb to 13½ lb. The ¼-in. and 5/16-in. welded steel wire design, replacing the strip, wire frame, and cast rim assembly, also allowed closer tolerances.

How redesigning with steel wire



BRACKET to hold two-way radio plugs on chassis. Cost reduction was 75 pct and weight savings 50 pct when the complicated six-part assembly was eliminated. Manufacturing time of this simple, two-part, ⅜-in. x 1/16-in., flat steel wire design, right, was considerably reduced.

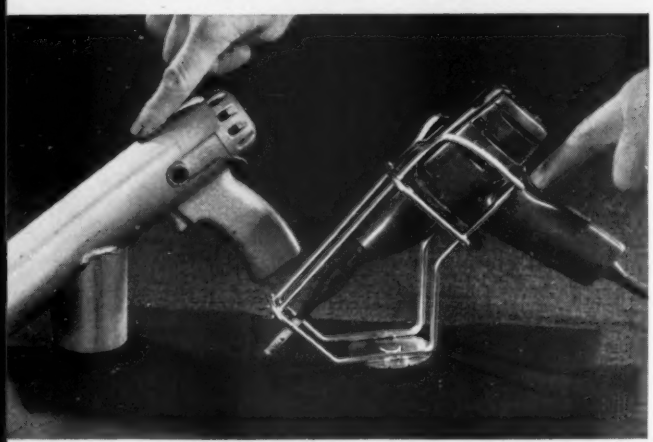
. . . cuts costs

. . . adds strength

. . . saves time

. . . reduces weight

HOLSTER for electric tool. The open wire frame reduced weight by 10 pct and cost by 66 pct. Replacing the welded tubing part, left, this steel wire assembly lends versatility in that it fits several types of tools.



These four examples show clearly why engineers and designers so frequently turn to steel wire for lower costs, simpler designs, and faster production.

Bethlehem makes wire for literally thousands of uses: upholstery spring wire, wire for cold-heading, wire for welded products, wire for handles, communications wire, etc. We regularly produce many grades of steel wire, with various coatings, processed in many ways to meet specific application requirements. Whether you need an ordinary or a special-purpose grade—our modern wire mills can produce it.

Our wire experts are at your service. A letter or call to your nearest Bethlehem sales office is all that's necessary.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

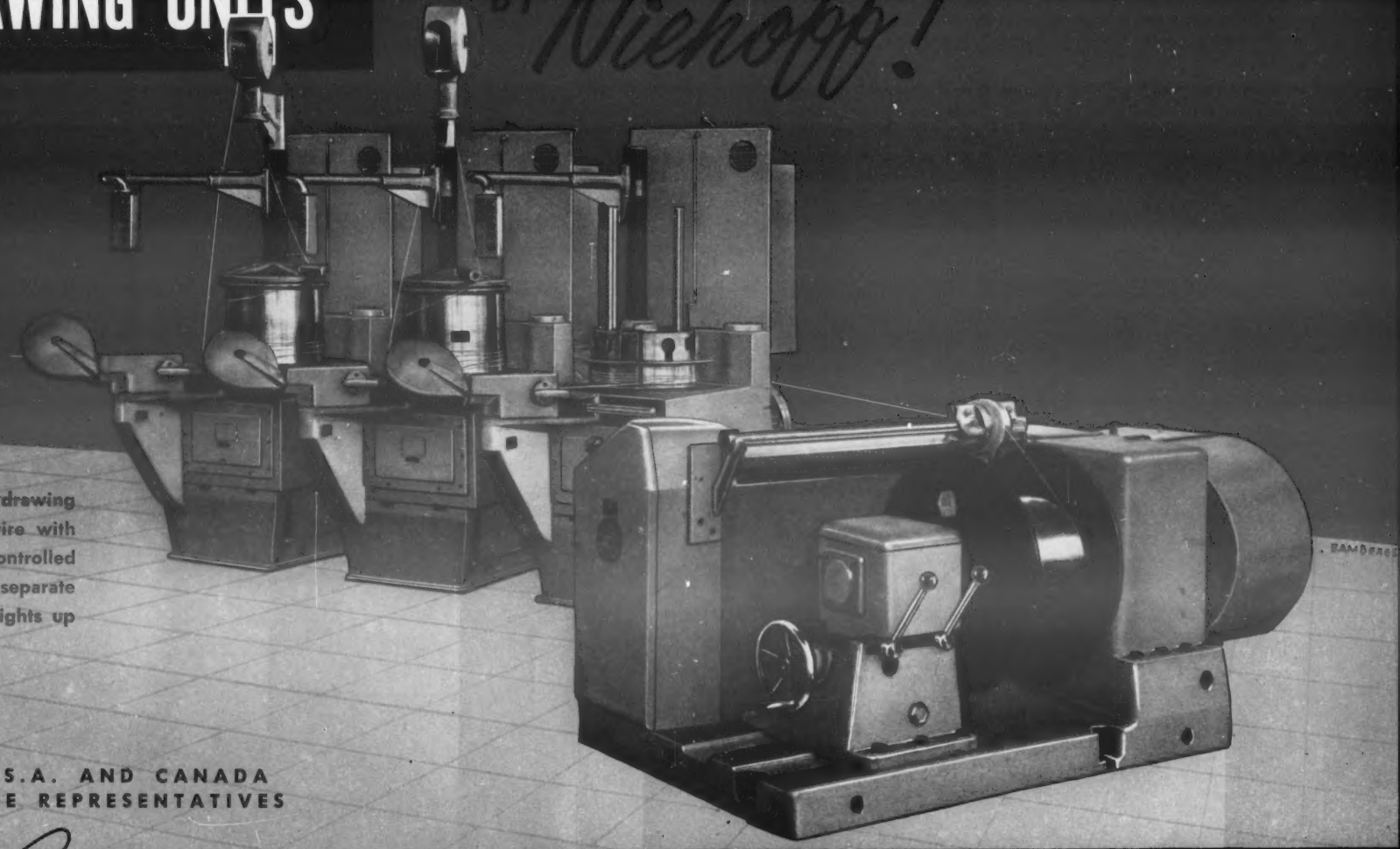
These case histories were furnished through the courtesy of E. H. Titchener and Co., Binghamton, N. Y., a regular user of Bethlehem wire.

BETHLEHEM STEEL

BETHLEHEM STEEL

WIRE DRAWING UNITS

BY *Niehoff!*



Latest type slipless drawing machines for steel wire with fully electrically - controlled and synchronized separate spooler for spool weights up to 3,300 lbs.

FOR U.S.A. AND CANADA
EXCLUSIVE REPRESENTATIVES

AMERICAN LAUBSCHER
Corporation

FISK BLDG. 250 WEST 57th STREET
NEW YORK 19, N. Y.

NIEHOFF

NIEHOFF MACHINE WORKS

SCHWABACH NEAR NURNBERG WESTERN GERMANY

Get the

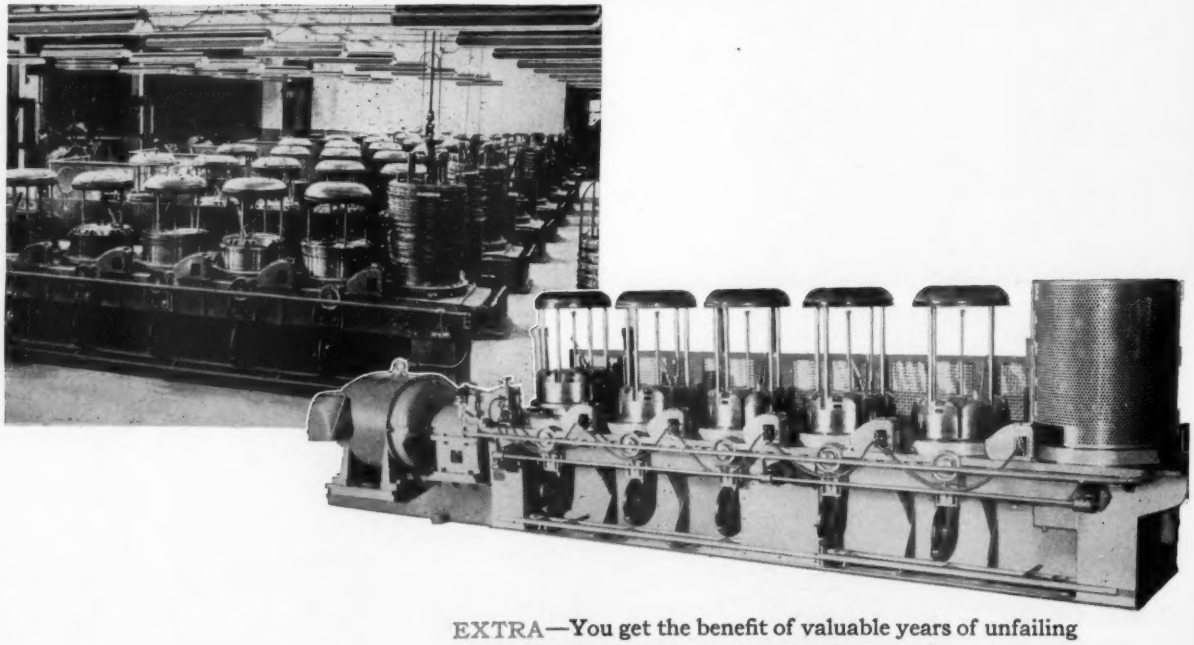
EXTRA

advantages of

IMPROVED

MORGAN-CONNOR

WIRE MACHINES



EXTRA—You get the benefit of valuable years of unfailing production-line performance—plus the latest improvements in every Morgan-Connor wire machine.

EXTRA—You get big, heavyweight bundles, with reduced down time and unloading time.

EXTRA—You get one motor—simplified drive and low power costs.

EXTRA—You get extra floor space because of compact design.

EXTRA—You get efficient, trouble-free performance from every machine. Write us for further information.

MORGAN CONSTRUCTION CO.

WM-118

WORCESTER, MASSACHUSETTS, U. S. A.

ROLLING MILLS | MORGOIL BEARINGS • WIRE DRAWING MACHINES • COMBUSTION CONTROLS

WIRE AND WIRE PRODUCTS*

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 34 November, 1959 No. 11

Designated as Official Publication By The Wire Association

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CONSISTENT QUALITY is wanted by most people but we often settle for less.

There is no need to settle for less when buying wire cutting tools.

CAREW cutters have given constant quality unequaled in 89 years.

MADE IN
4 SIZES
8", 10",
12", 14"

Jaws are made of hardened tool steel and are replaceable.

Made by

M. W. ROBINSON
COMPANY
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Slip sheer silk across a CLARK spool . . .

no snagging burrs, safe for hands and wire

Smooth, rounded edges of Clark wire spools eliminate any possibility of injury to hands or your product. Safety is one of the *many plus features* you get from J. L. Clark's superior spool technology.

Clark reinforces the strength of steel with locked-seam construction and a continuous bond between barrel and head which totally prevents independent turning of end, cap or center.

Select from a wide range of standard end diameters—or let Clark solve your special problem for any type of insulated or fine wire spool.

Your established design can be faithfully reproduced—or we will create a new one for you.

Sales-winning lithography by Clark—brilliant, critically accurate—establishes instant recognition for your brand.

Aren't these reasons why you should check on Clark's wholly integrated spool service? For complete details, ask for our booklet, "Spools for Insulated Wire." *J. L. Clark Manufacturing Co., Rockford, Illinois; Liberty Division Plant and Sales, Lancaster, Pa.; New York Sales Office, Chrysler Bldg., New York 17.*

lithographed metal containers

J. L. CLARK

VYGEN® special PVC compounds and resin

FOR WIRE AND CABLE COATING

In addition to Vygen 120 PVC resin, there are *three* specially-formulated Vygen compounds completely tested and UL-approved for specific wire and cable applications. Available in quantities to fit your needs, each Vygen compound and resin is composed of the very finest raw materials, processed in the most modern facilities. Each is designed to do its job better, *and* to save you money. Send for generous samples, literature and technical assistance.

VYGEN 6812 COMPOUND

UL-approved for UF-NMC cable, Type T, TW, 60°C, Oil, and 80°C appliance wire applications. May also be used as primary insulation for other cable constructions and jacketing.

VYGEN 6035 COMPOUND

UL-approved for Type T, TW, and exposure to oil use at 60°C. This compound combines excellent physical and electrical properties with very good weather and flame resistance.

VYGEN 9221 COMPOUND

Meets UL requirements for 90 and 105°C applications. Recommended for appliance, radio hook-up, machinery wire etc. where heat resistance and good physical properties are required.

VYGEN 120 RESIN

UL-approved as interchangeable with other PVC resins used as wire insulating material. For fast dry-blend extruding with monomeric or polymeric plasticizers—assures lack of gelled particles, excellent heat and light stability and long life.

TYPICAL ANALYSIS

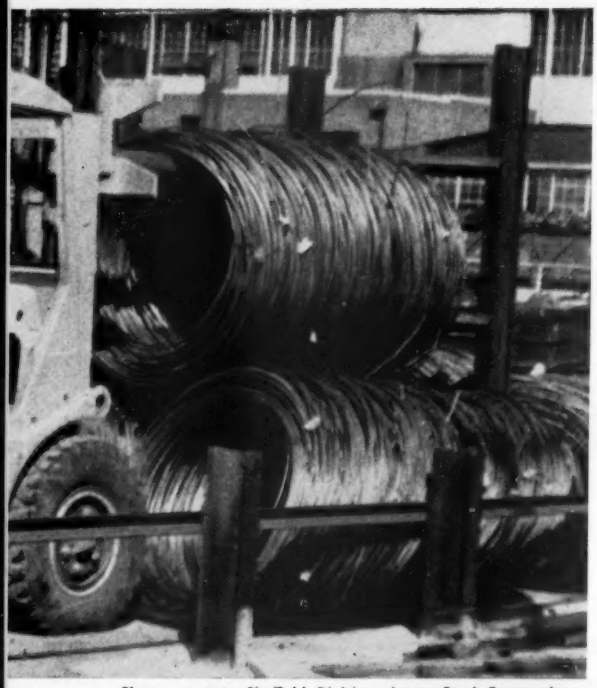
Form	White Powder
Intrinsic Viscosity	1.18
Specific Gravity	1.40
Bulk Density, gm/cc	0.52
lbs/ft³	32.5
Volatiles	0.2

Creating Progress Through Chemistry

PHYSICAL PROPERTIES OF MOLDED SPECIMENS

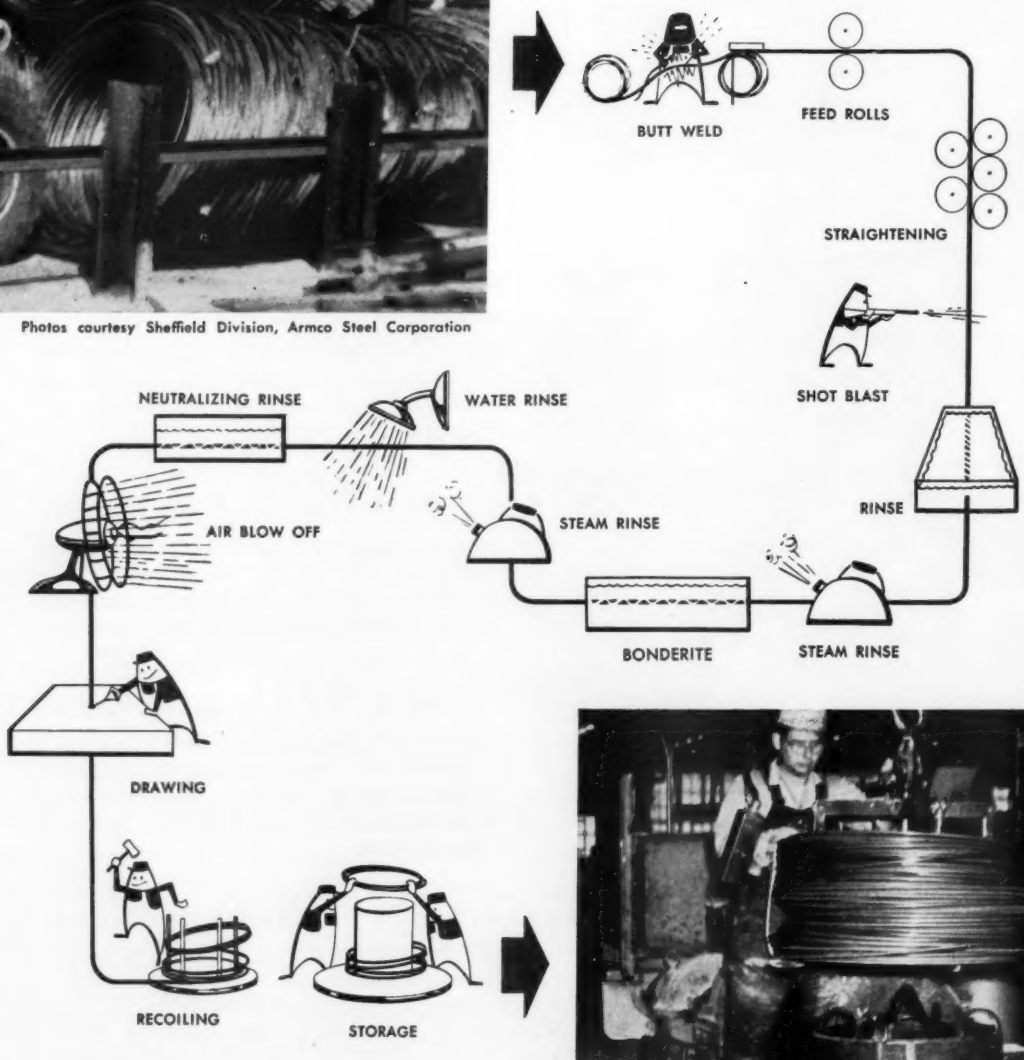
	6812	6035	9221
Specific Gravity at 25°C/4°C	1.32	1.33	1.38
Tensile, psi at 25°C	2550	2950	3100
Modulus at 100% Elongation, psi	1450	1780	2150
Elongation, % at 25°C	320	315	340
Hardness, Shore A, inst at 25°C 10 sec at 25°C	90 82	94 86	97 92
Brittle Point, at – 15°C	Passes	Passes	Passes
Volume Resistivity, ohm-cm at 25°C and 50% R. H.	3.1×10^{14}	2.8×10^{14}	3.5×10^{13}

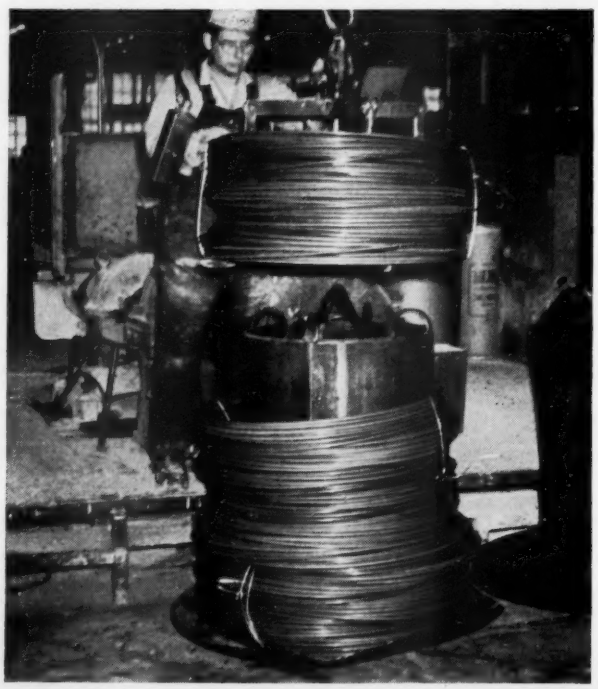
Chemical Division GENERAL THE GENERAL TIRE & RUBBER CO. VYGEN



Photos courtesy Sheffield Division, Armco Steel Corporation

***HOT ROLLED ROD**—With Stran Bonderite in your plant, you can store rod in the yard. Schematic drawing shows processing.*





***SIZED OR FINISHED WIRE**—Wire, finished with the aid of Stran Bonderite, is readied for storage before going to cold heading machines.*

STRAN BONDERITE

revolutionizes cold heading and high carbon wire drawing in a continuous operation

Now—with Stran Bonderite—Parker has scored another breakthrough, this time in cold heading and wet or dry high carbon wire drawing.

This revolutionary development treats rod or wire in a continuous strand, creating a uniform coating and lubrication in a few seconds as the strand moves at production speeds.

The Stran Bonderite system produces cleaner wire, eliminates acid disposal problems and saves space. All this is accomplished with substantial overall cost savings and reduced labor.

An added benefit is the increased corrosion resistance afforded by the Bonderite coating, even after it has been through the dies. Finished coils remain rust-free and ready for use.

COLD HEADING—Manufacturers who have installed the revolutionary new Stran Bonderite system are reporting these benefits:

- *Improved lubrication makes it possible to do more difficult jobs.*
- *Tool life is greatly improved.*
- *Better dimensional tolerances are held.*
- *Residual coating increases die life in thread rolling.*

HIGH CARBON WIRE DRAWING—Among the advantages of Stran Bonderite in wet or dry high carbon wire drawing are these:

- *Improved lubrication eliminates many of the problems in the production of drawn shapes.*
- *Stran Bonderite greatly increases die life which results in close dimensional tolerance over long production runs.*
- *The chemically applied coating retains lubrication more effectively to permit higher drawing speeds.*

Since 1914—leader in the field

Stran Bonderite is ready to save you money in your plant—and give you a better product. It has been thoroughly production tested.

We will be glad to tell you how it is saving money for many manufacturers today, how it will fit economically and efficiently into your operations. (Bonderite is also available for immersion application where conventional pickle house preparation is used.)

Write or call for expert help today!

Parker Rust Proof Company

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BONDERITE corrosion resistant paint base	BONDERITE and BONDERLUBE aids in cold forming of metals	PARCO COMPOUND rust resistant	PARCO LUBRITE—wear resistant for friction surfaces	TROPICAL—heavy duty maintenance paints since 1883

**Bonderite, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.*

this is a Nail!

It's a special kind of nail, knurled for greater holding ability and produced by machines which not only make nails, but at the same time drive and countersink them in leather or wood at rates up to three per second.

The wire used by these nailing machines must meet critical specifications. It must be ductile enough to form a perfect head and clinch when needed, yet be hard enough to penetrate tough grains and knots. Moreover, it must be consistent in quality throughout its length.

For 26 years, PAGE has supplied wire which meets exactly the requirements of the manufacturer of these machines—The Auto-Soler Company, Atlanta, Georgia.

Regardless of *your* use of wire, you can count on PAGE uniformity. Whether you make hairpins or lock washers, PAGE wire will give you the tensile strength, ductility, finish, tolerance and other properties you require.

PAGE facilities are designed to produce a wide range of high quality manufacturers wire items—including special shapes. Where requirements are exacting, you will find PAGE wire unexcelled.

Since 1902, we have pioneered many "firsts" in the wire industry. The latest of these is corrosion-resistant ACCO *Aluminized* Wire—commercially pure aluminum bonded to a steel core.

LET'S TALK WIRE! Get in touch with us for your wire needs. Gain the benefit of PAGE experience and "wire know-how" to improve your product and lower your costs.

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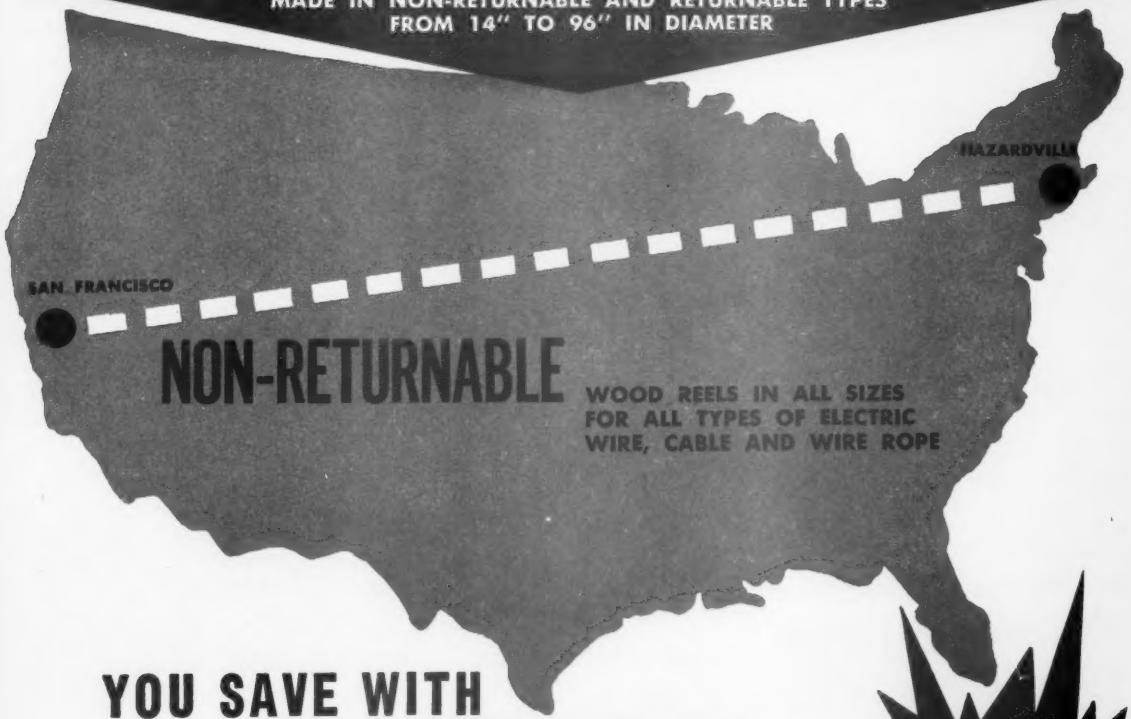
PAGE *—the source for answers to wire problems*

A BOARDWALK FROM HAZARDVILLE TO SAN FRANCISCO

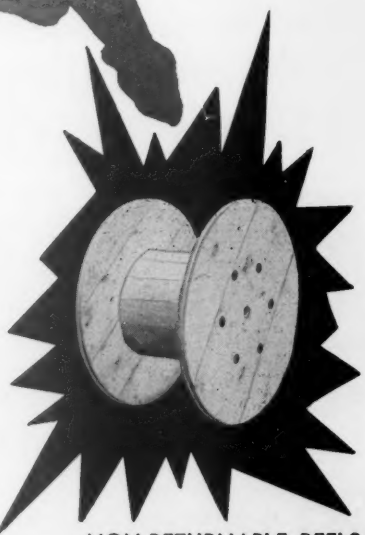
The wood used in the manufacture of BRIDGE REELS, in one average year's production, would make a boardwalk one-inch thick and twelve inches wide stretching over 3,000 miles across the country — OR — it would provide enough lumber to build 3,000 six-room houses — THAT'S QUITE AN OPERATION! The important deduction, however, is that BRIDGE REELS for WIRE, WIRE ROPE and CABLE are good enough to meet the exacting demands of most of the big wire plants of the country.

MADE IN NON-RETURNABLE AND RETURNABLE TYPES
FROM 14" TO 96" IN DIAMETER

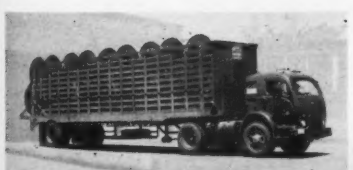


YOU SAVE WITH NON-RETURNABLES

- Reduced Reel Investment
- Less Storage Space
- Lower Freight Costs
- No Repair Costs
- No Return Freight Charges
- No Bookkeeping
- No Deposits Needed
- No More Headaches!!



NON-RETURNABLE REELS GIVE YOU A DEFINITE PACKAGING COST.



HIGH SPEED
SHIPPING SERVICE IN OUR OWN TRUCKS

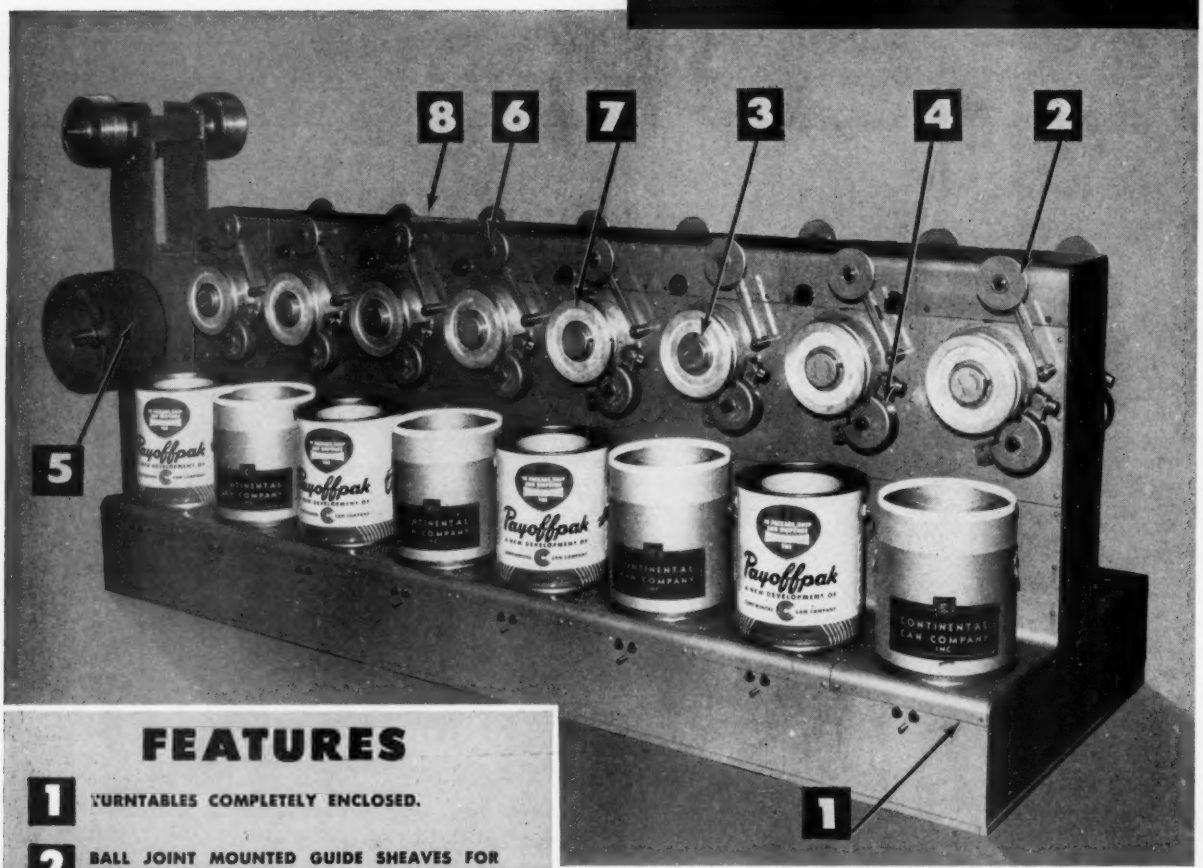
within a radius of 250 miles from the plant. Fast freight will bring you Bridge reels within a few days east of the Mississippi.

"REEL GOOD . . .

Let us quote on your reel needs. Send us your specifications. Better yet, visit our plant and see how and why Bridge reels are made so well at so low a cost.

WOOD REELS"

ANNOUNCING the WYREPAK



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2. BALL JOINT MOUNTED GUIDE SHEAVES FOR ALL ANGULAR SETTINGS.
3. ELECTRO-MECHANICAL TENSION CONTROL FOR EACH HEAD.
4. PRECISION GROUND PRESSURE ROLLS.
5. PRIME RUBBER LAGGED CAPSTAN.
6. ASSEMBLED AND ALL ADJUSTMENTS MADE WITH ALLEN SCREWS.
7. ALUMINUM CAPSTANS, WITH HARD-ANODIZED, POLISHED RUNNING SURFACES.
8. INDIVIDUAL MAINTENANCE ON EACH SECTION.

The drum packaging Take-Up System illustrated, Model S5-TC-S, was designed especially for Magnet Wire.

Other models are made for all types of ferrous and non-ferrous wires.

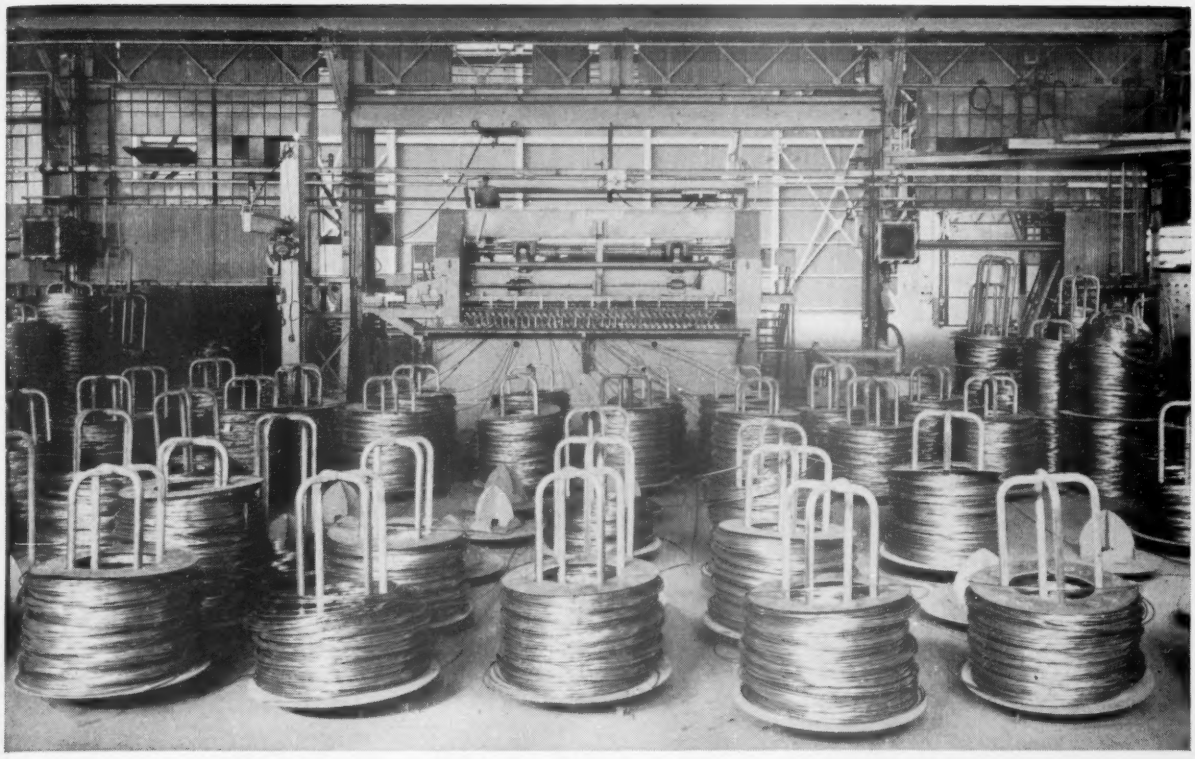
Advanced engineering and precision construction have evolved in this machine new concepts of speed and efficiency in the packaging of wire. Capacity: Min. size — #32 ga.; max. size — #20 ga. wire.

YOU ARE INVITED TO SECURE COMPLETE DETAILS REGARDING THIS ADVANCED PROCESS FROM —

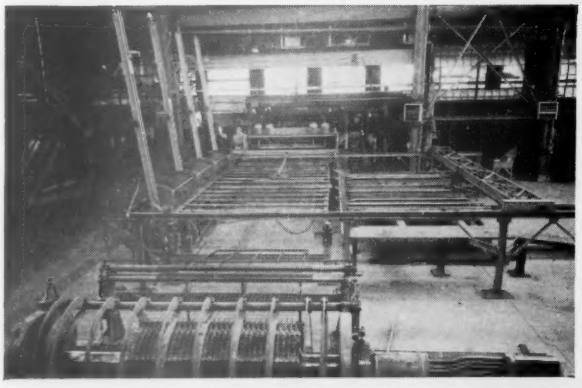
Advanced Wyrepak Co., Inc.

11 HARRISON COURT PHONE: EDison 4-4274 BRIDGEPORT, CONN.

OR The Vaughn Machinery Co., CUYAHOGA FALLS, OHIO



Let DSC LPR COILS help cut your brite wire fabricating costs as they have done for our Portsmouth Division on Welded Wire Fabric



Look closely at the entry side of this giant Welded Wire Fabric machine. This one produces mesh in widths up to 13′, used for reinforcing concrete in road, pipe and other construction. Fed by as many as 80 - 3,000 pound Brite Wire LPR's running simultaneously off as many reels, it produces rolls from 300′ to 500′ long, weighing up to about 6,000 pounds. The flat mats or sheets run up to 30′ long.

In the photograph at the right, you see the delivery side of the welder, shear in the background, coiler in front and, in between, the fully automatic "flipper" and piler . . . the only one of its kind, we are told.

Our original purpose in developing continuous-length, long-production-run LPR's was to improve the efficiency of our own mesh operations. Compared with regular mill coils weighing about 300 pounds which we used previously, our 3,000 pound LPR's reduced downtime frequency by 90% and attendant coil-change and other costs proportionately.

PRACTICAL POINTERS on wireworking and complete information on DSC LPR's are available to you for the asking—call your nearest DSC Customer "Rep" office or write to Detroit Steel Corporation, General Sales Office, Box 4308, Detroit 9, Michigan.

FREE: Reprints of *"The Drawing and Handling of Long Production Run Wire Coils"* . . . a paper by Uno V. Johnson, Superintendent, Portsmouth Division Rod and Wire Mill, presented at the October Wire Association Convention . . . Send requests to Detroit Steel Corporation, Box 4308, Detroit 9, Michigan.

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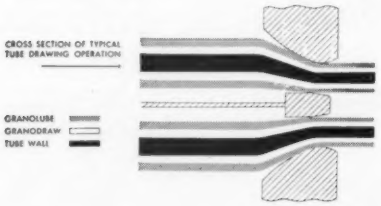
CHEMICAL CONVERSION COATINGS and their functions in facilitating the cold mechanical deformation of metals

By ARTHUR DAHL, Product Development Dept., AMCHEM PRODUCTS, INC.

When used to facilitate the cold mechanical deformation of metals (in drawing, extrusion, stamping, cold heading, necking, and upsetting operations) chemical conversion coatings in conjunction with suitable lubricants perform three important functions. One, they prevent metal-to-metal contact between work and tool. Two, they prevent galling and seizing. Three, they protect stock indefinitely, permitting the storage of in-process work at any stage of production, without danger of corrosion damage.



Characteristic of the tightly bound, highly absorptive, crystalline coating formed by the processes is the ability of the coating to retain lubricity throughout forming operations when treated with a suitable lubricant. This offers the following production advantages:

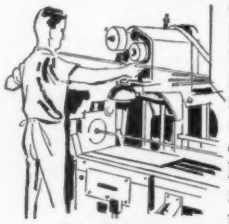
- **Higher degree of reduction**
- **Greater speed of draw**
- **Longer tool life**
- **Fewer process anneals and pickling**
- **Finer surface finish**
- **Cleaner mills**
- **Easier inspection of finished product**

Also of interest to production men is the exact duplication of coatings from batch to batch. And the processes are much simpler than other methods of coating metals—baths can be set up and running in less time than it takes to determine suitable coatings by other methods.

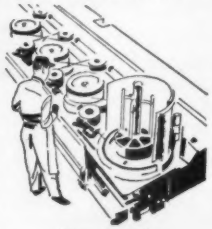
TYPES OF COATINGS AND THE METALS FOR WHICH THEY ARE DESIGNED

Zinc phosphate coatings for carbon steel. These coatings can be applied by either dip or spray systems.

Dip. Amchem Granodraw No. 1 is typical of the dip process. The sequence includes precleaning, water rinse, pickling, water rinse, water rinse, Granodraw No. 1 solution, water rinse, and a hot neutralizing rinse. Surfaces to be treated must be free of oil, grease, rust and scale. The above sequence insures that they will be. And when metal is free of rust and scale, the pickling bath and two succeeding water rinses can be omitted. In either case, a lubricant like Amchem Granolube or conventional lubricant must be applied prior to working the metal.

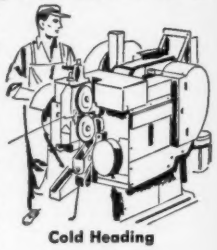

Tube Drawing

Spray. Amchem Granodraw No. 4 is an example of the spray process. It usually requires 5-stage equipment and includes the following steps: precleaning, water rinse, Granodraw No. 4 solution, water rinse, lubricant. After chemical treatment, the work must be dried before forming.

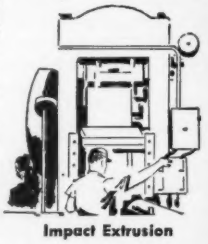

Wire Drawing

Oxalate Coatings for the stainless steels and many of the high-nickel alloys. These coatings are applied only by immersion process, and usually in a 5-stage system which includes an acid pickling or depassivating bath, a water rinse, the Amchem Granodraw SS coating bath, a hot borax neutralizing rinse for wire stock, or a lubricating bath for tube stock. Since thorough activation of the metal surface is necessary to promote an adherent coating, the pickling and activating bath is an important stage in processing.

Fluoride-type coatings for zirconium and its alloys. Granodraw ZR is such a coating. It is applied in an immersion process which includes precleaning, water rinse, pickling, water rinse, Granodraw ZR solution, water rinse, drying or lubricating. It has been used primarily in the treatment of stock prior to wire drawing and tube drawing. Surfaces are cleaned of oil and grease by solvent degreasing or alkali cleaning. Pickling is required to provide a surface that is chemically and metallurgically receptive to the coating.


Cold Heading

Amorphous phosphate coatings for aluminum. This type of coating is now in the development stage. Laboratory and field tests are being conducted, results are being evaluated, and modifications in chemical make-up and process sequence are being made to meet requirements. Several field tests, however, have indicated that it will do the same job for aluminum processors as the other types of coatings have done for those working carbon steel, stainless steel, high-nickel alloy, and zirconium.


Impact Extrusion

For more information write us at Ambler.

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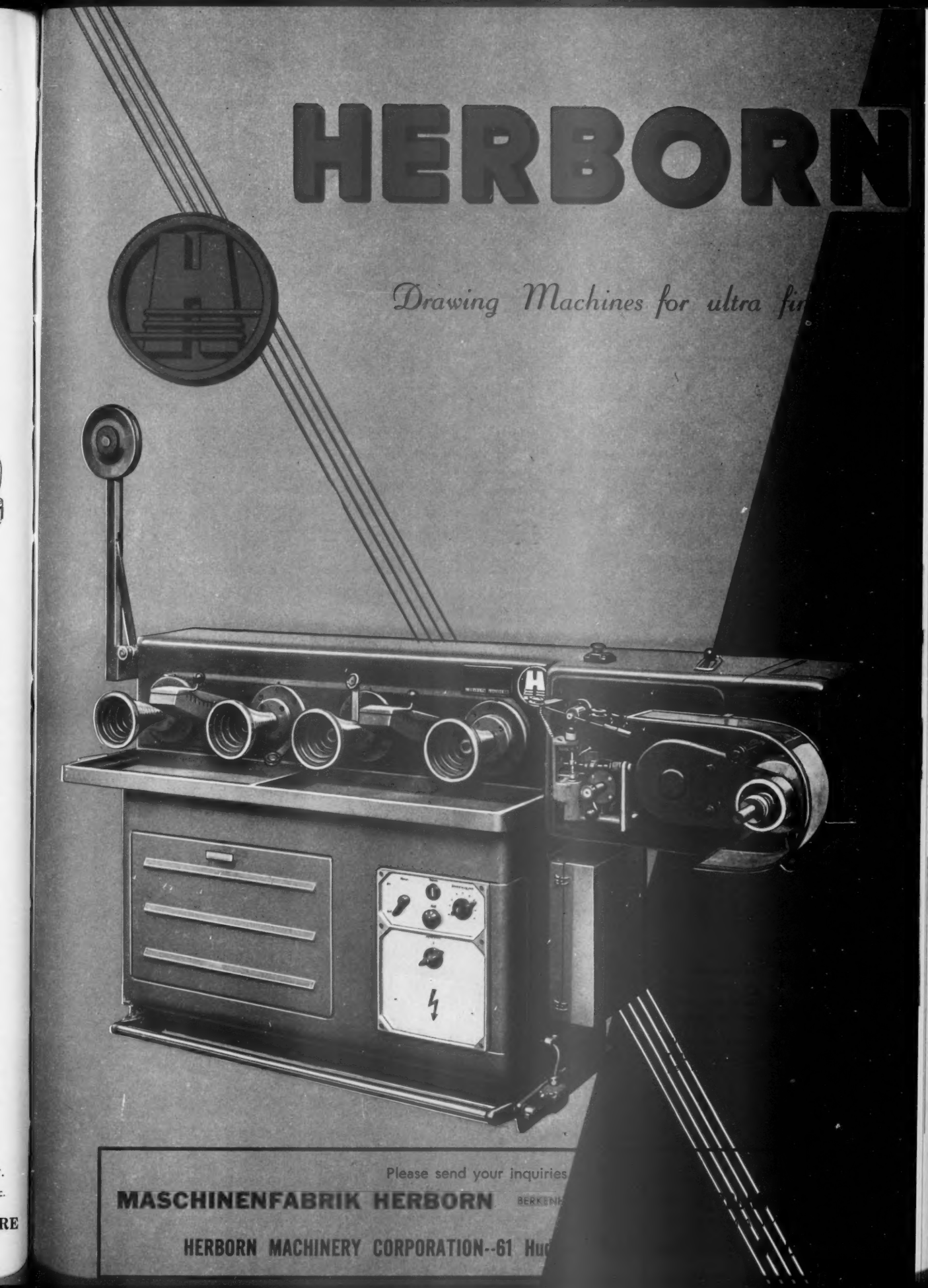
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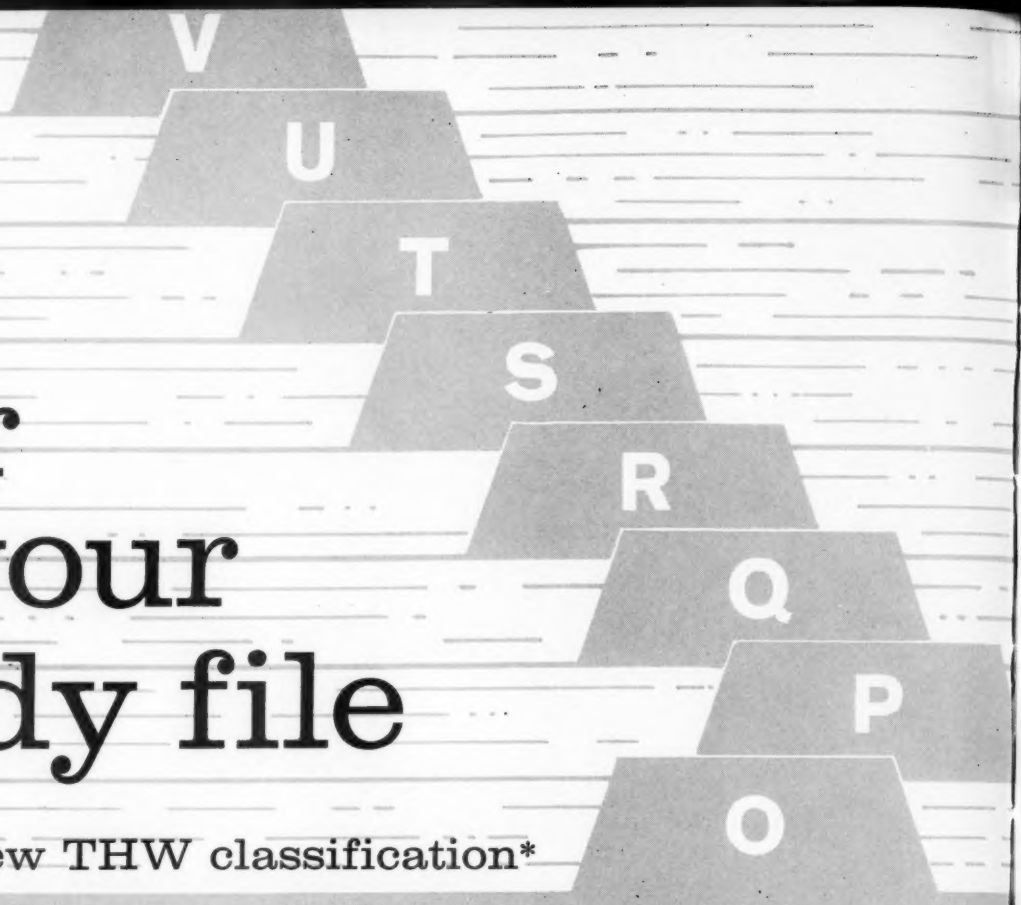

for your ready file

To meet new THW classification*

Monsanto OPALON 71345 vinyl compound

PHYSICAL PROPERTIES	UL SPECIFICATIONS FOR THW	TYPICAL TEST VALUES FOR OPALON 71345 (#14 AWG solid wire with 3/64" insulation)
1) Tensile Strength, psi	2000 min.	2550
% Retention (aged 7 days @ 113°C)	75 min.	105
2) Elongation, % Retention	150 min.	295
(aged 7 days @ 113°C)	75 min.	91
3) Deformation, T_2/T_1 (1 hr. @ 121°C, 500 gm. wt)	0.70	0.88
4) Vertical Flame Test	Pass	Passes
5) Heat Shock Test, 121°C.	Pass	Passes
6) Mechanical Water Absorption mg/in^2	20 max.	10-13

ELECTRICAL PROPERTIES	UL SPECIFICATIONS	OPALON 71345
1) Specific Inductive Capacitance		
1000 cycles at 75°C.	10 max.	7.4
1 day	5 max.	2.3
% change 7-14 days	10 max.	7.2
2) Insulation Resistance megohms/1000 ft.		
1 day at 15.6°C.	150 min.	4200
1 day at 75°C.	0.1 min.	6.1
1 week at 75°C.		4.8
10 weeks at 75°C.		5.5
28 weeks at 75°C.		5.6
3) Conductor Corrosion	None	None
4) Dielectric Strength, volts	3000	over 20,000
1 day at 15,6°C.		

(1959 edition of the National Electrical Code of the National Fire Protection Association)

*Under the new THW classification, up to 20% more current can be run through conductors than could be with TW conductors. Smaller conductors can be used, saving conduit space, cutting wiring costs. Maximum operating temperatures raised from 60° to 75° C. Good electrical properties, moisture and heat resistance, aging characteristics, economical performance, processability and freedom from conductor corrosion, make Opalon 71345 ideally suited for THW usage. For complete technical and processing data on Opalon 71345 write to Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.

OPALON: REG. U. S. PAT. OFF.

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working together for 30 years to maintain wire rope leadership —

For more than three decades, Keystone has worked closely with Broderick & Bascom Rope Co., St. Louis, Mo., to produce superior quality wire that meets the ever-changing demands of the wire rope industry.

A good example is the large 3⅛" Yellow Strand "Powersteel" Dragline Rope with a breaking strength of 448 tons. This strong, abrasion-resistant, high-carbon steel wire rope was developed to match the increased capacity, power and speed of today's giant draglines and strip mining equipment.

Sharply contrasting to the big rope is the 1/32", 1 x 7 Galvanized Aircraft Strand—also illustrated—one of the smallest B & B wire ropes.

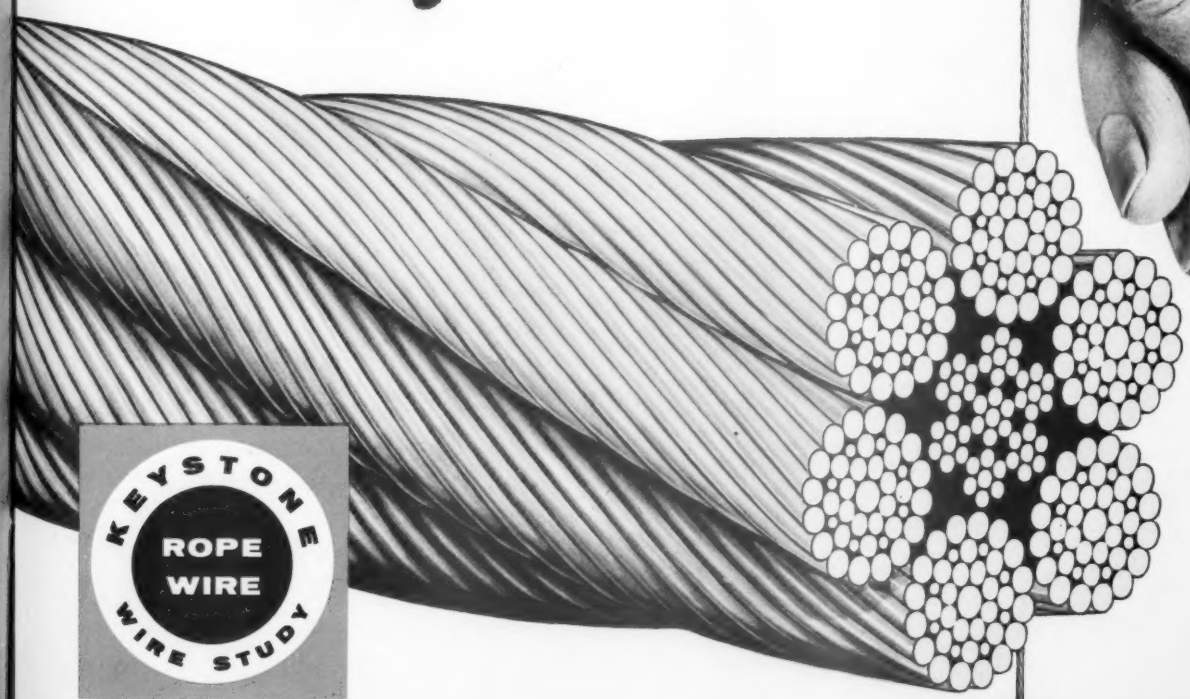
Keystone and B & B engineers together have developed unusual manufacturing methods to produce a wire rope with superior performance.

You, too, can enjoy these sales advantages and create customer demand by specifying Keystone Wire wherever wire is used in your products. Call your Keystone representative!

Keystone Steel & Wire Company, Peoria 7, Illinois

KEYSTONE
WIRE FOR INDUSTRY

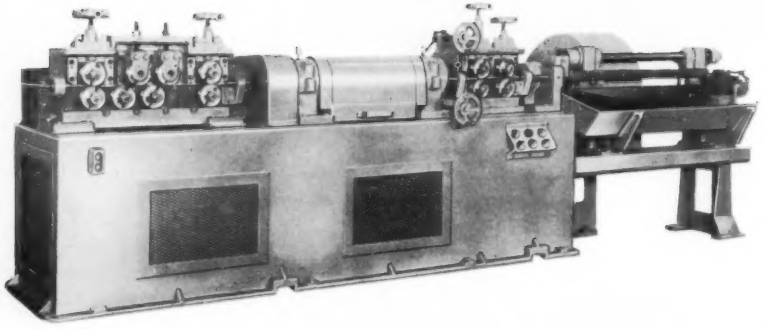
The large wire rope consists of 295 individual wires, laid up into 6 strands of 41 wires each with Independent Wire Rope Core. The small, galvanized aircraft strand is made up of 7 wires.



KEYSTONE ROPE WIRE WIRE STUDY

SHUSTER®

Wire Straightening and Cutting Machines your BEST BUY!



Illustrated **MODEL 4AV**
3/8" to 11/16" basic wire,
feeds from 90 to 180
feet per minute.

MODEL 3AV
1/4" to 1/2" basic wire,
feeds from 76 to 228
feet per minute.

MATERIAL: Wire in coils purchased at lowest price.

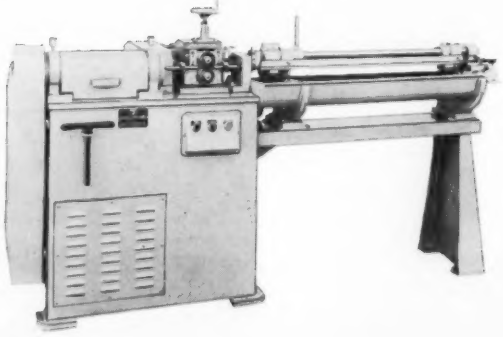
STORAGE: Less floor space required than for storage of straightened and cut lengths.

DELIVERY: *When* you *need* it. Eliminates damaged wire waste.

COST: SHUSTER is the oldest (1866), most dependable name in wire straightening and cutting. Always ahead with the best, *tested* machine refinements, SHUSTERS cost *less* than any comparable machine.

SHUSTER
Wire Straightening and Cut-off Machines and Components are built in 49 models from .020" to 11/16" Mettler Machine Tool also manufactures the SHUSTER 5/16" capacity. Thread Rolling Machines

SINCE 1866



Illustrated here is NEW SHUSTER Model 1AVS 3/16" and 1/4" Capacity WIRE STRAIGHTENING & CUTTING MACHINE.

CAPACITIES 1AVS—5
.062" to .250" basic wire
.062" to .148" spring wire
50 to 200 F.P.M.

METTLER MACHINE TOOL, INC.

155 W. Adeline, New Haven, Connecticut

FLEXAL S	Hot dip, dry film lubricant and rich, dry drawing compound.
FLEXAL MCA	Metallic stearate base. Medium varigrind compound.
FLEXAL MCF	Metallic stearate base. Rich, fine mesh drawing compound.
FLEXAL MCL	Lean, fine, dry lubricant for low carbon bright and cold heading wires.

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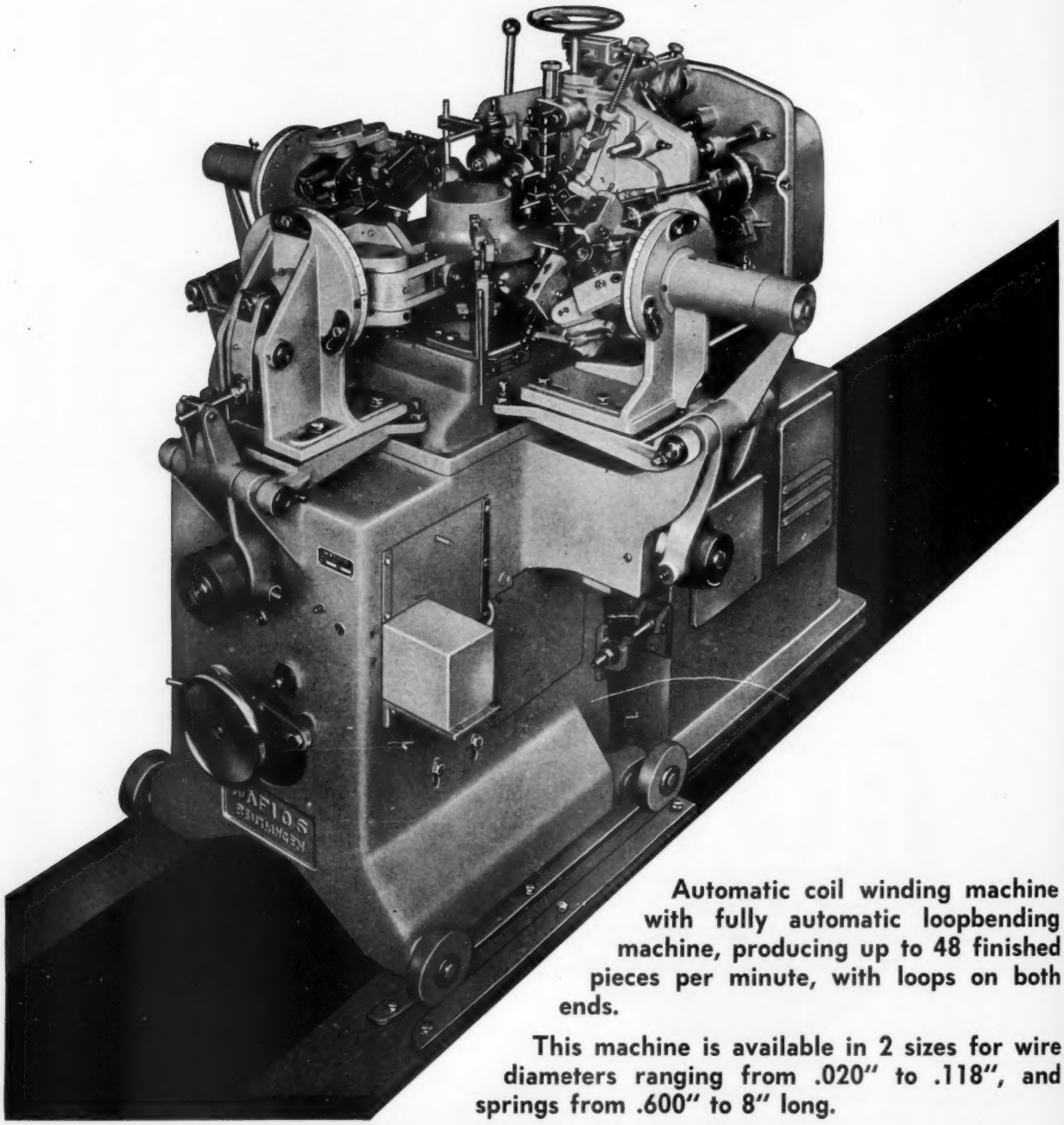

Automatic coil winding machine with fully automatic loopbending machine, producing up to 48 finished pieces per minute, with loops on both ends.

This machine is available in 2 sizes for wire diameters ranging from .020" to .118", and springs from .600" to 8" long.

U. S. OFFICE:

WAFIOS MACHINERY CORPORATION, 61 Hudson Street, Hackensack, N. J. Tel. HUbbard 9-7577

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WAGNER, FICKER & SCHMID **REUTLINGEN/WURTT., GERMANY**

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WHY WAS IT CHOSEN BY MAJOR AIRCRAFT MANUFACTURERS FOR JET PLANE WIRING?

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These modern instruments have been in operational use for over two years and have been approved and accepted by the world's largest manufacturers of insulated wires.

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Predictable Performance

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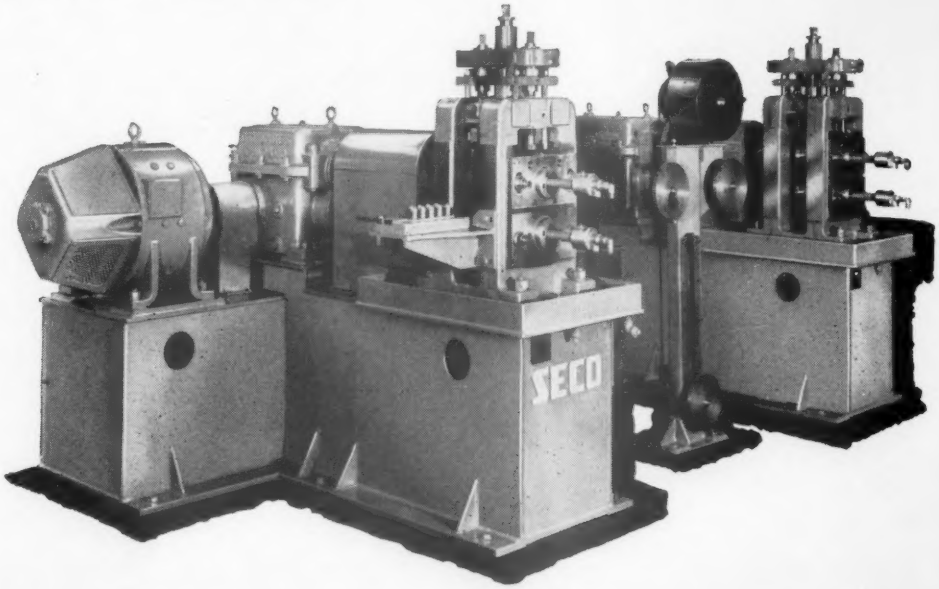
SECO **WIRE FLATTENING MILLS**



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Seco's staff of trained engineers . . . specialists in solving production problems . . . are available for personal assistance to you. Call us today.

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- Multiple Strand Pull-out Rolls and Take-up Frames
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- Scrap Ballers

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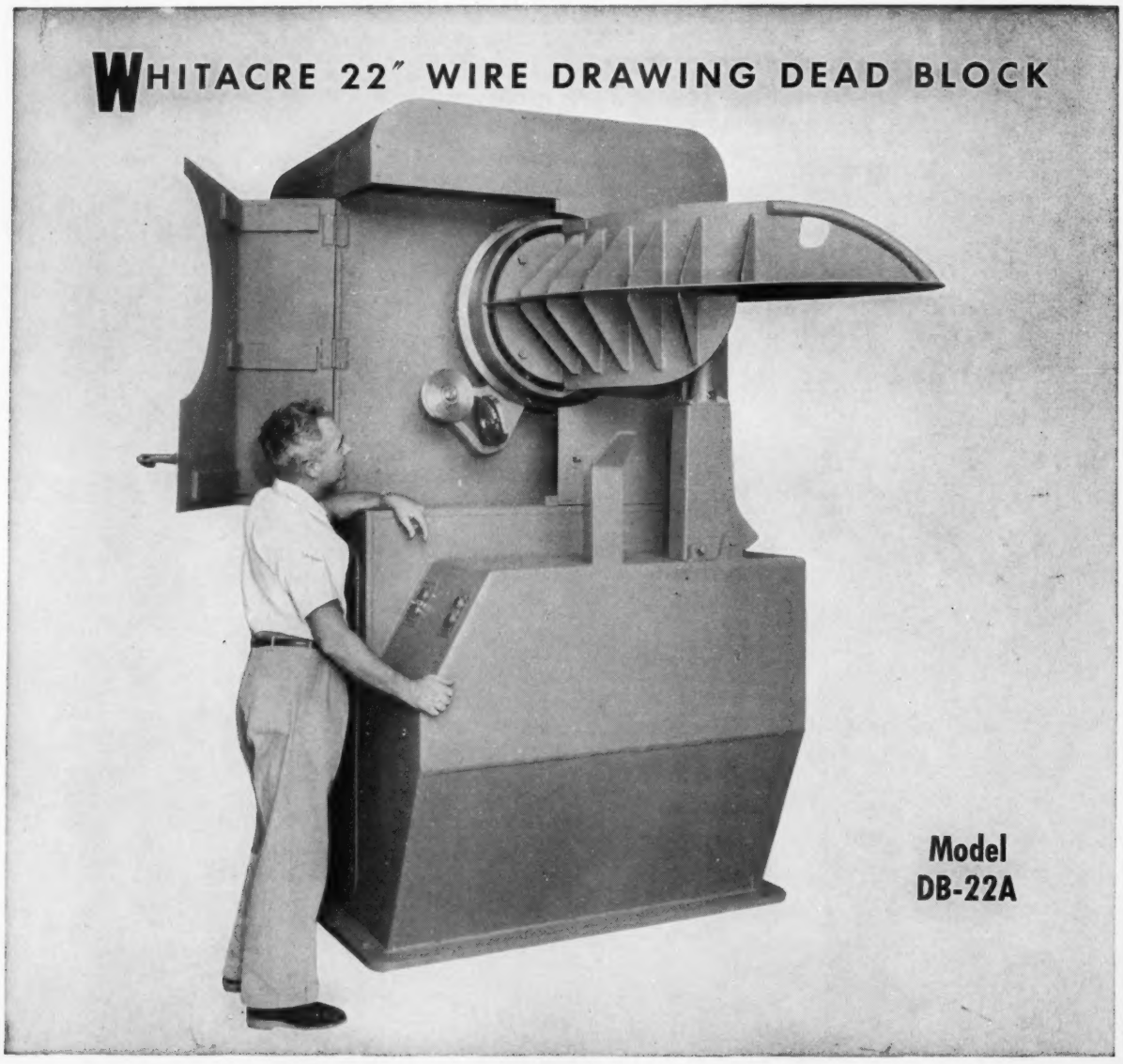
AFFILIATED WITH *Lee Wilson* ENGINEERING CO., INC.

WHITACRE 22″ WIRE DRAWING DEAD BLOCK



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DB-22A

Continuous Production—Efficiency Approaching 100%

Gives you these advantages

Continuous increased production achieved by: • No down time for stripping • Permits packaging into stationary container or uninterrupted palletizing on stems • No tangling nor snarling from handling • Design simplicity. No back-gearing nor similar mechanisms • Greatly reduced floor space requirements • Dies in supplying drawing machine can be changed without stopping dead block • Accumulation type machines can be "run down" without stopping dead block • Continuous inspection and sampling • Breaks welded in production — low scrap loss • Increased production with lessened operator fatigue • Maintenance eliminated except for occasional lubrication of four main bearings and two motor bearings • Dead block can be located anywhere with wire literally piped from wire drawing machine • Extra large packages for in-process wire • Greatly reduced handling and in-plant transportation costs • Low capital investment.

OTHER MODELS AVAILABLE

16″ Wire Drawing Dead Block, Model DB-16A • 26″ Wire Drawing Dead Block, Model DB-26A • Combination 16″ and 22″ Galvanizing or Tinning Dead Block Take-ups, Model GB-2216A • 26″ Heavy Wire Galvanizing or Tinning Dead Block Take-up, Model GB-26B.

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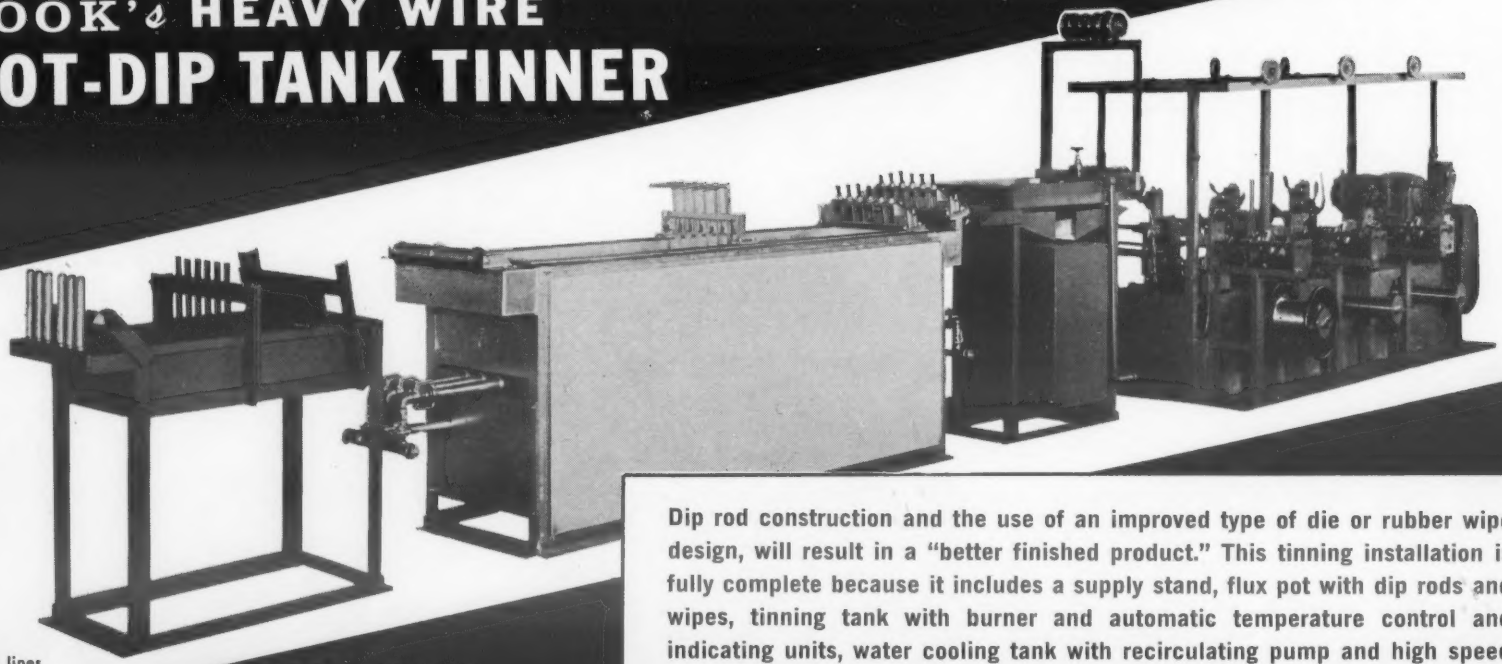
and get production up to 3600 feet per minute with*
COOK's HEAVY WIRE
HOT-DIP TANK TINNER



* Using 6 lines of No. 18 wire

Dip rod construction and the use of an improved type of die or rubber wipe design, will result in a "better finished product." This tinning installation is fully complete because it includes a supply stand, flux pot with dip rods and wipes, tinning tank with burner and automatic temperature control and indicating units, water cooling tank with recirculating pump and high speed take-up. Gives wire smooth, perfect uniformity. Flexible in design. Built of rugged, all welded parts. Guarantees up to 600 feet per minute per line speed. Represents a low initial investment for you! And remember, this machine can be custom designed to suit your existing reels or other specialized requirements.

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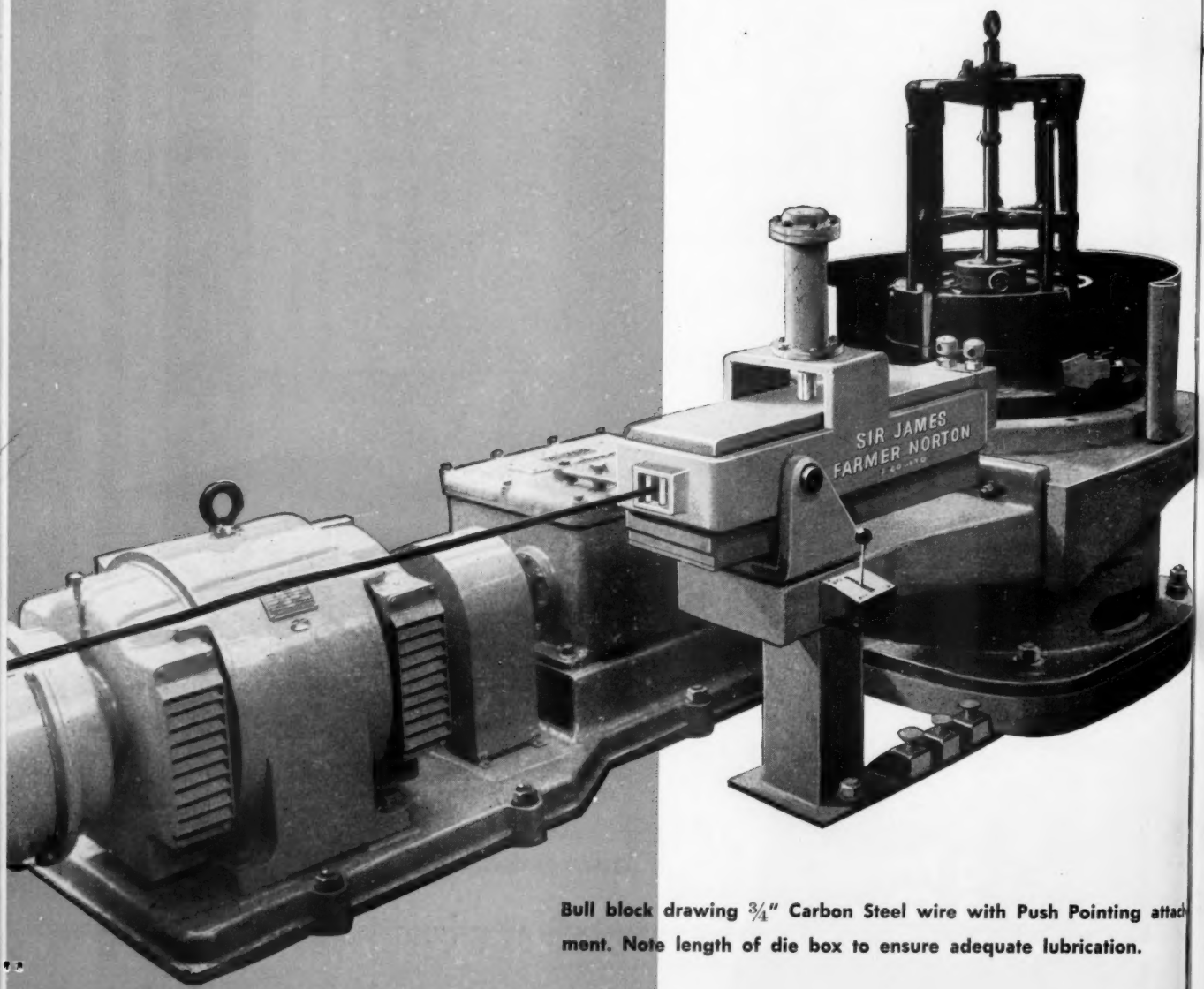
Farmer Norton

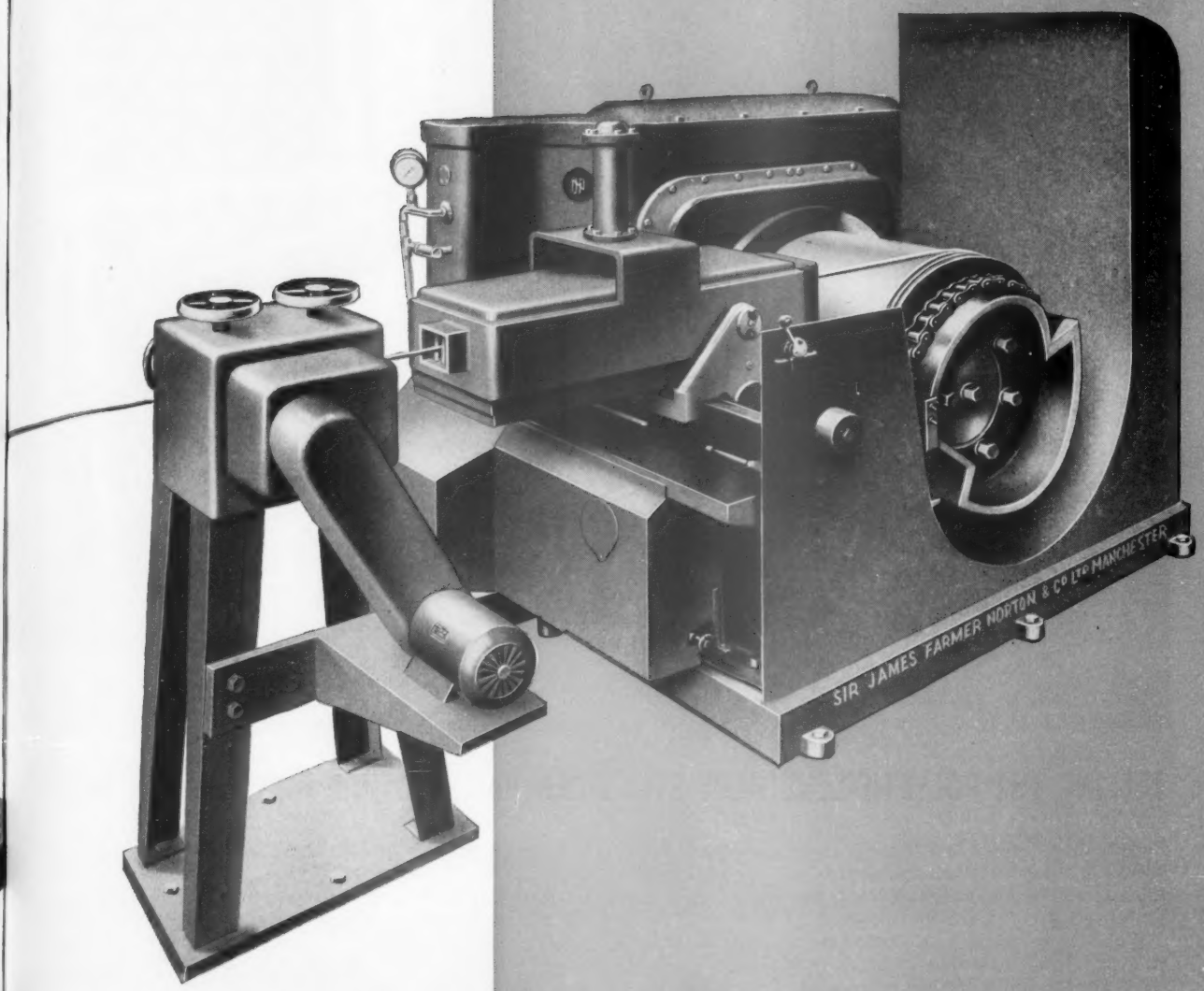
Push Pointing Units

for Wires from 1⅛" to ½" dia.

These Hydraulic Units can be fitted to practically any Bull block drawing heavy rods down to ½" diameter. The handling and pointing of heavy rods has always been a laborious and lengthy process. It is now possible to point and draw on the same machine. The Farmer Norton Push Pointing Unit straightens the first end and points the wire by driving it through the drawing die. The 'dog' may then be attached to the 'tag end' and drawing commenced.



Bull block drawing ¾" Carbon Steel wire with Push Pointing attachment. Note length of die box to ensure adequate lubrication.



Horizontal bull block for 1⅛" diameter Bolt Wire. 36" diameter block. 30ft /min. 80ft /min. 110ft /min. Straightening roll and push pointer supplied.

Sir James Farmer Norton & Co. Ltd.

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DON'T GET ME WRONG...I STILL DON'T LIKE STORMS
"But they don't seem to hit us so hard any more.
Not since polyethylene coated wire came along."

TELLING THE POLYETHYLENE WIRE STORY CAN BUILD FUTURE PROFITS FOR YOU

Polyethylene-covered line wire has many advantages for users: Exceptional weather and stress-crack resistance. Easy handling and installation. Long life in service. Fewer outages and minimum maintenance.

We've been telling your customers the polyethylene story in utility magazines through advertisements like those above. And more and more users are specifying polyethylene covering for line wire and many other applications. Why not join us in this effort?

Polyethylene can make your operations simpler, with a more profitable future too.

- The resin comes ready-to-use — nothing to add, no blending, no milling, no post-extrusion vulcanizing. With production based completely on polyethylene, one line replaces several, providing savings in equipment, floor space, maintenance and labor. And there's only one material to purchase and inventory.
- Unlike costs of other insulating materials, which are trending upward, polyethylene price history promises long-term stability. This means polyethylene can be expected to be your most profitable line wire coating in the years ahead.

You can build a solid base for future sales and increased profits by promoting polyethylene line wire now among your customers and prospects.

As you make recommendations, you will find our new data sheet, "PETROTHENE® Resins for Wire and Cable Industry", helpful in selecting resins with the proper balance of properties for different applications. Also available is U.S.I.'s comprehensive 100-page "PETROTHENE Polyethylene . . . A Processing Guide." Write for your copies.

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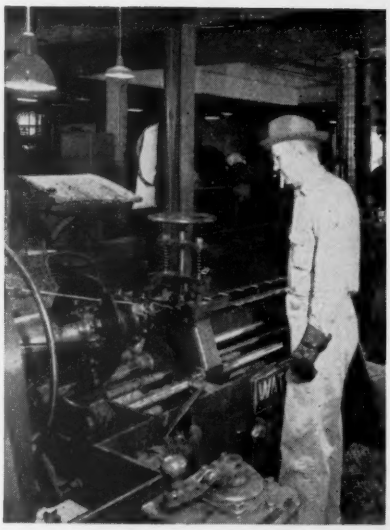


Youngstown Rope Wire
passes through preforming head and closing die, to become Broderick & Bascom's famous "Yellow Strand" wire rope.

Accent on Excellence

Youngstown rope wire

Lifting a mighty fir or a stalled automobile, a sling of wire rope is tough to beat for speed, safety and handling ease. Long experience, sound engineering and only the best materials—that's what it takes to make a good sling, and Broderick & Bascom makes them for almost every lifting job you can name.

This leading maker of slings and wire rope never compromises with quality. They count on Youngstown Rope Wire to uphold their reputation—*and it does.* Broderick & Bascom "Yellow Strand", and extra high-strength "POWERSTEEL" wire rope are made of Youngstown Rope Wire that consistently meets the most exacting quality standards.

Wherever steel becomes a part of things *you* make, the high standards of Youngstown *quality*, the personal touch in Youngstown *service* will help you create products with an "accent on excellence".

The Youngstown Sheet and Tube Company, Youngstown, Ohio.
Carbon, Alloy and Yoloy Steel.

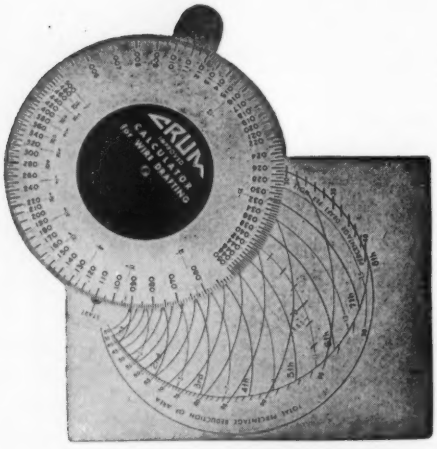
Youngstown

QUALITY YOUNGSTOWN SERVICE

SAVE SET-UP TIME WITH THE...

CRUM CALCULATOR
FOR WIRE DRAFTING

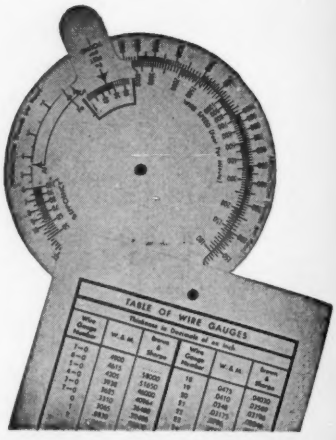
Useful and Accurate!



Front view of Crum Calculator

THIS NEW DOUBLE-PURPOSE CALCULATOR WILL:

1. **Provide quicker and more accurate information on die sizes and reduction areas;**
2. **Calculate wire production rates for various speeds and efficiencies.**



Reverse view of Crum Calculator

SOME OTHER FEATURES OF THE CALCULATOR

- Has new scale for more accurate determination of small percentages.
- Gives readings in B & S gauges.
- Intermediate lines provide reductions for 16 holes in one setting.
- New rectangular shaped back for better protection of calculator.
- More legible % draft-per-hole scale.
- Vinyl plastic construction, resistant to wear, warping, dirt, perspiration, wire drawing soaps—can be cleaned.
- Still fits your vest pocket.
- Handy tables of W & M and B & S gauges.
- Feet per pound calculating scale for steel, copper and aluminum wires.
- Durable, accurate, easy to use.

The improved Crum Calculator is worth its weight in gold in time saving—no laborious mathematical calculations necessary when you use it. Instruction sheet with examples accompany each Calculator. You should have one or more in your wire drawing department.

THE PRICE: $5.00 EACH

Send your orders to:

WIRE AND WIRE PRODUCTS

453 MAIN STREET **STAMFORD, CONN.**

(Exclusive distributors)

ECONOMIC PRODUCTION FLEXIBILITY for ROD and WIRE ANNEALERS

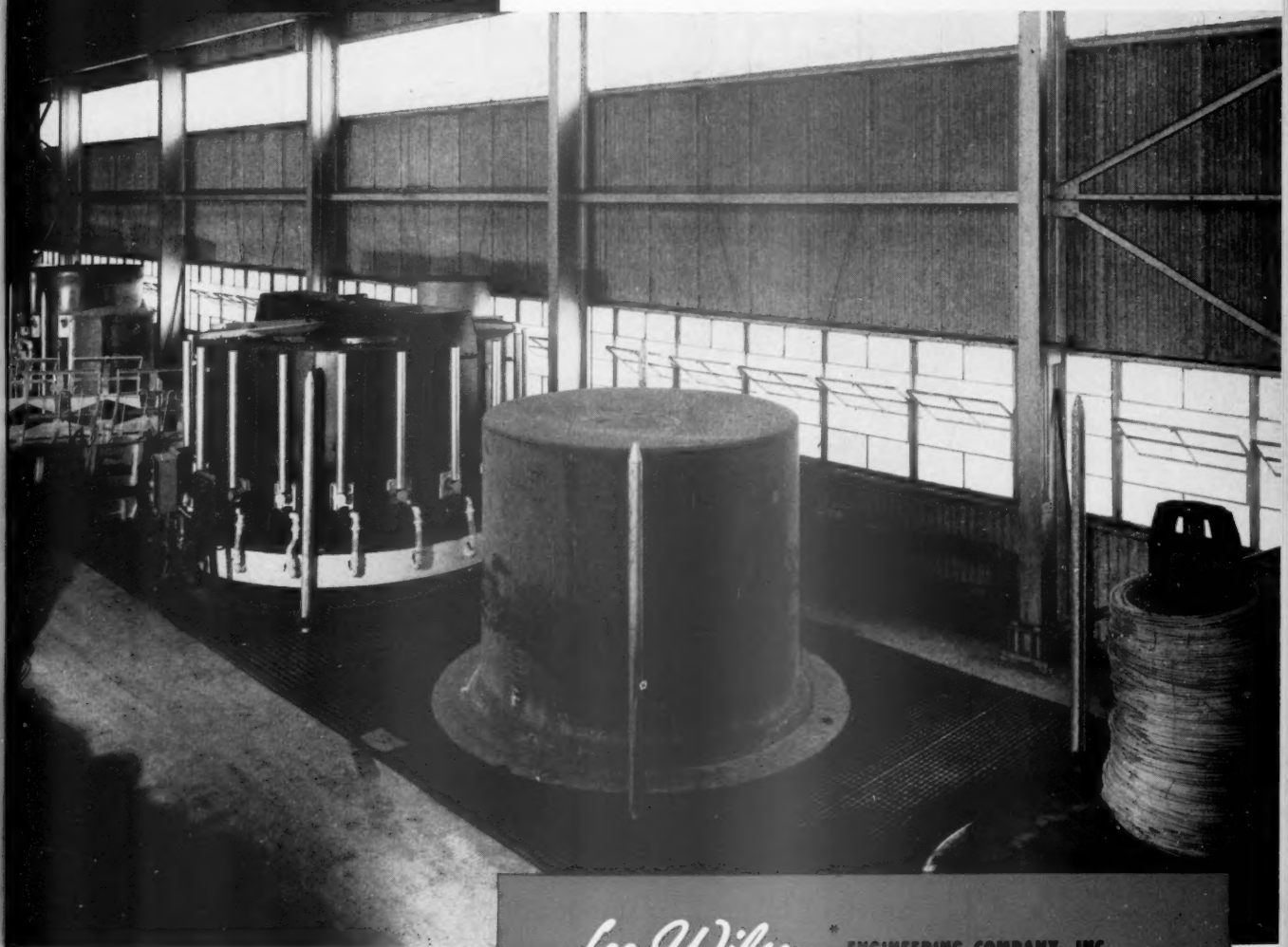
LEE WILSON engineers design system for Russell, Burdsall & Ward

Economic flexibility—that's what Russell, Burdsall & Ward have in their new annealing and spheroidizing department at their Rock Falls, Illinois, plant.

At the time RB&W decided to reconstruct their annealing operation they asked Lee Wilson engineers to design the most efficient system possible for operation under any economic condition. With flexibility as the keynote, Lee Wilson engineers reconditioned three small single-stem furnaces and added one new 108" x 90" big three- or four-stem furnace, a complete nitrogen plant and a Lee Wilson automatic loading and unloading system.

Today RB&W have an annealing-spheroidizing department that will quickly and most economically convert any amount of stock material to the specification required. They will never get "caught short" by shortages for they now have the flexibility to convert stock rod into what they need to fill even the smallest order.

Only the Lee Wilson high convection bell type annealing furnaces can give you uniform annealing quality and the ability to adjust production to the business level.



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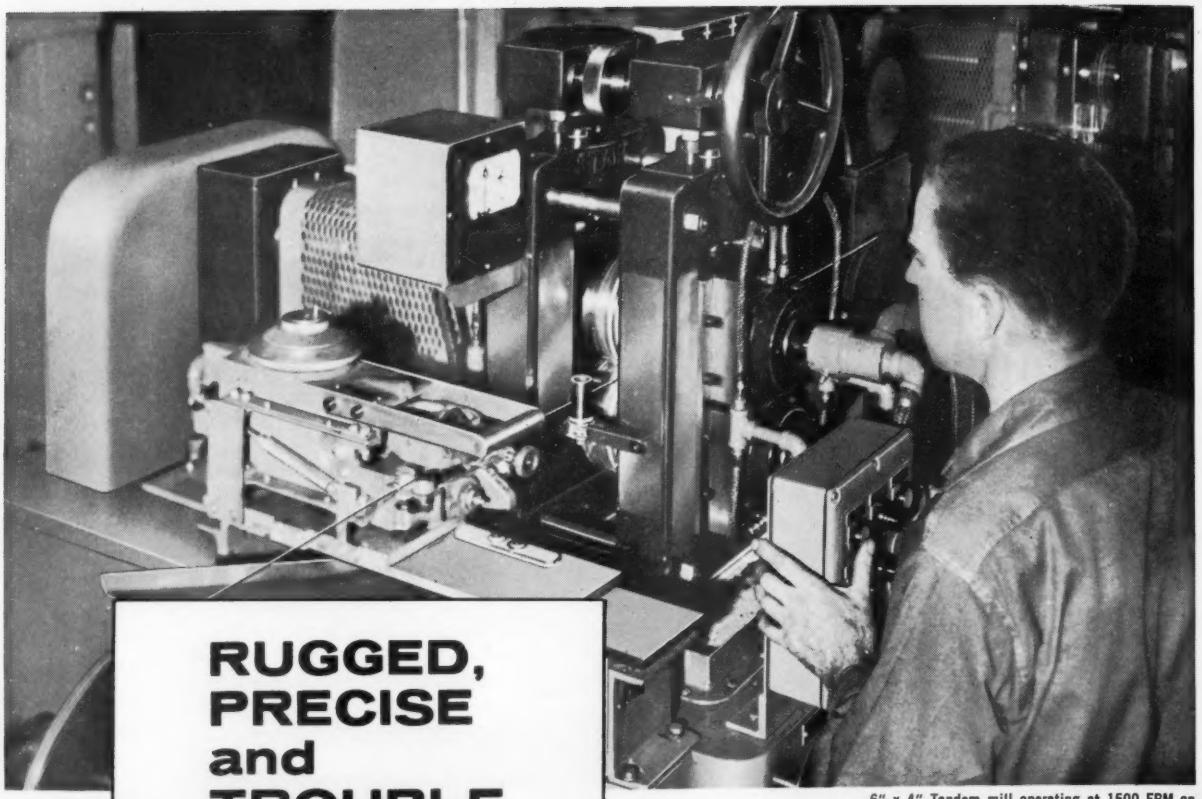
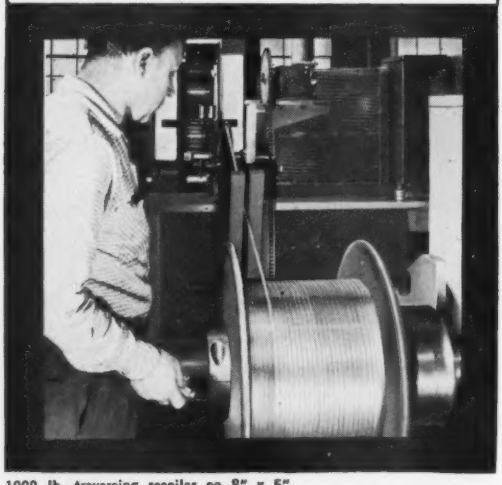


6" x 4" Tandem mill operating at 1500 FPM on high carbon steel at Page Steel Division—ACCO.

RUGGED, PRECISE and TROUBLE FREE



1000 lb. traversing recoiler on 8" x 5" tandem line at Kagan Dixon Wire Corp.

STANAT WIRE FLATTENING MILLS

Stanat mills are designed to consistently give you extremely close tolerances combined with high speed production.

Simplicity of design insures minimum maintenance and frequently permits one man operation.

All Stanat mills include such quality features as completely enclosed permanently lubricated worm gear screwdowns; fully adjustable traversing recoiler; herringbone drive; anti-friction bearings at all critical wear points.

Stanat single and tandem wire flattening mills are available in sizes up to 10" roll diameter either as completely self-contained package units or as individual components for erection at your plant.

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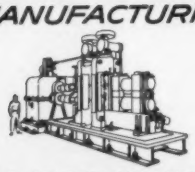
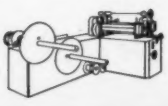
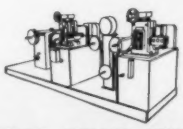
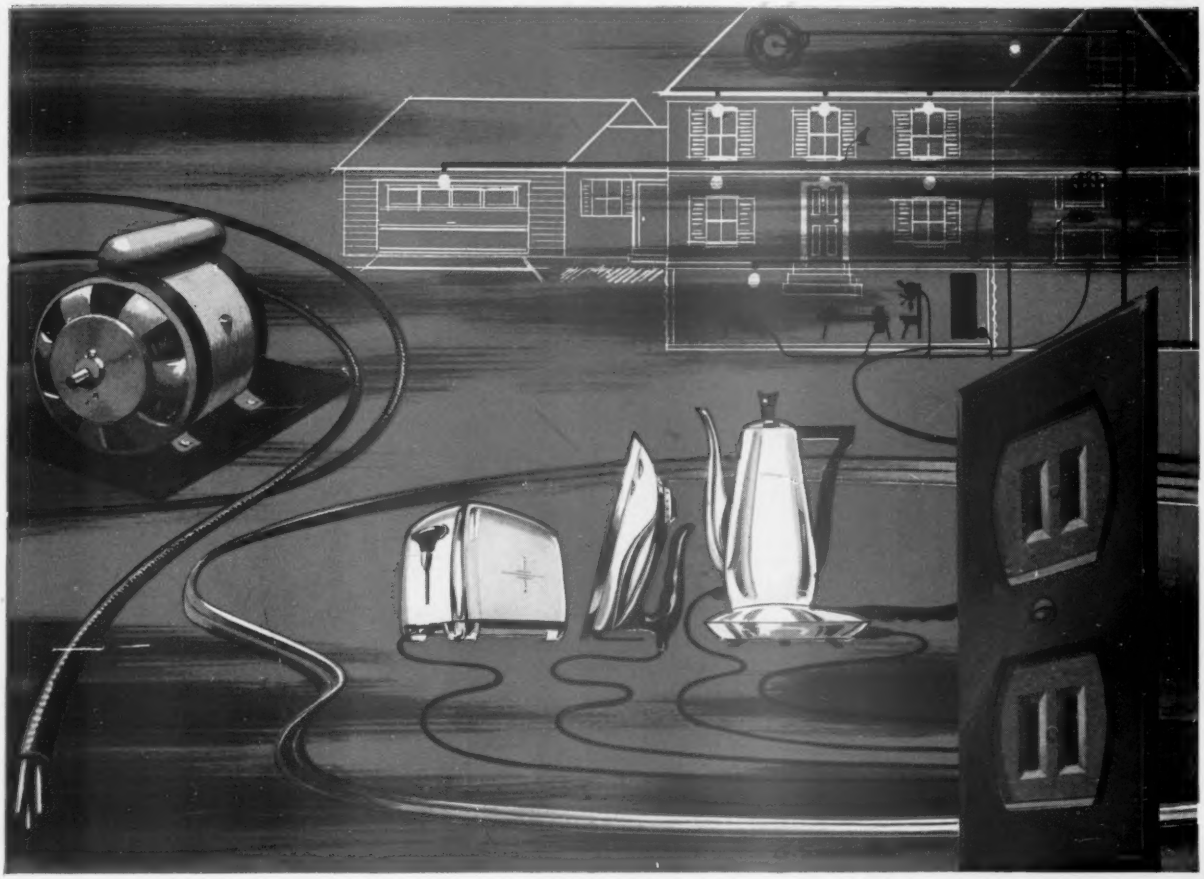
MANUFACTURING CO., INC. / IN EUROPE: STANAT-MANN, ESSEX, ENGLAND

MFR'S OF ROLLING MILLS, GANG SLITTERS, WIRE FLATTENING MILLS, ROLLER LEVELERS AND BULL BLOCKS

Naugatuck MARVINOL

POLYVINYL CHLORIDE RESINS



four resins for electrical application

NAUGATUCK now offers the Wire and Cable Industry *more* PVC resins for insulation extrusion than does any other resin manufacturer.

Two of these Marvinol® resins, VR-22 and VR-23, have UL approval. These resins are, respectively, of high and intermediate molecular weight. Both have good dry blending properties.

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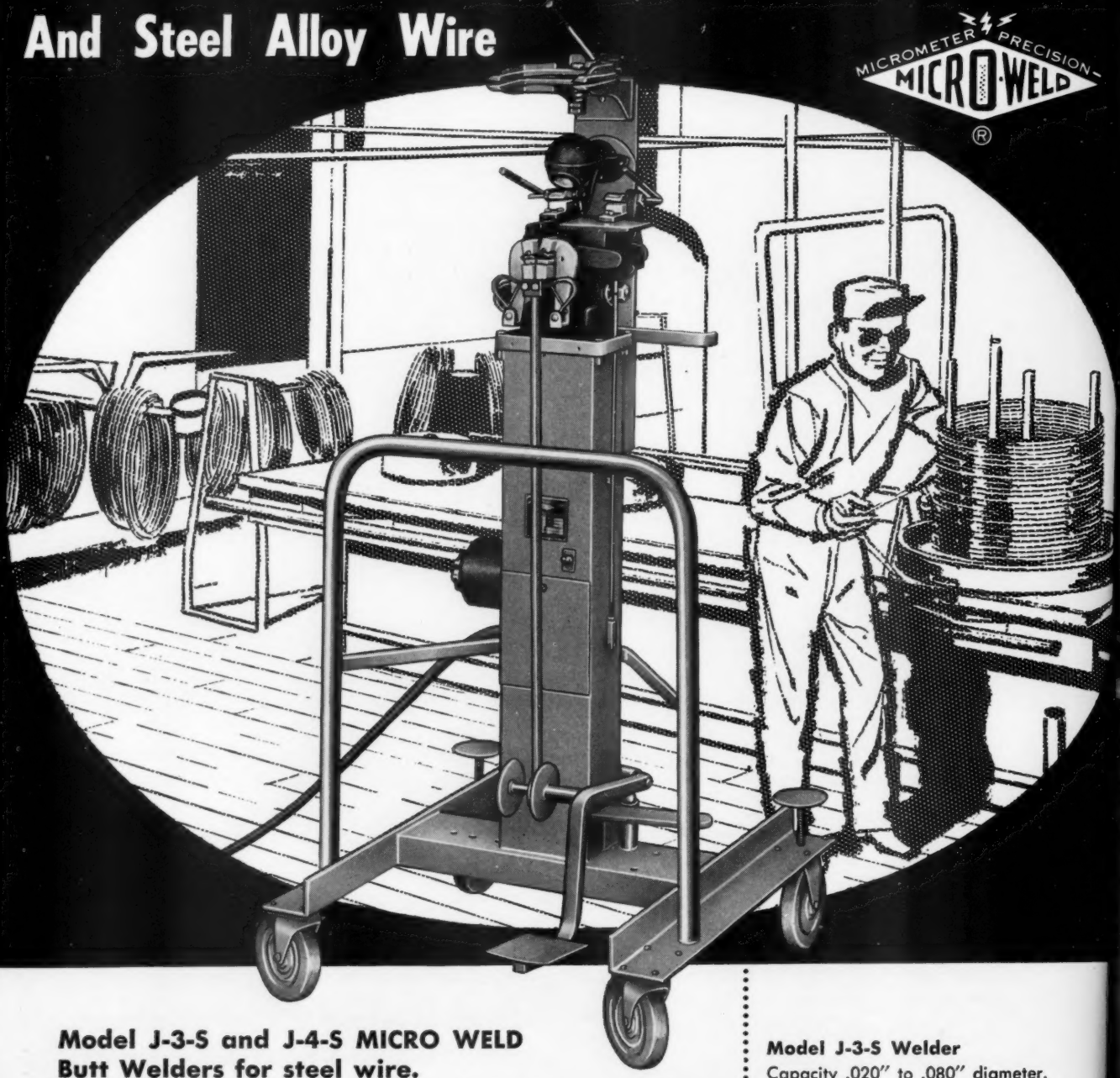
Fast Operating Utility Type Models J-3-S & J-4-S Automatic MICRO-WELD Butt Welders For Steel And Steel Alloy Wire

MICROMETER PRECISION MICRO-WELD ®



Model J-3-S and J-4-S MICRO WELD Butt Welders for steel wire.

These welders are used for welding high and low carbon Steel & Steel alloy wire ranging in size from .020″ to .160″ diameter.

All operations on these units, which include clamping the wire, contacting the weld switch, and applying the upset spring pressure, are made by a single downward stroke of the foot pedal.

Model J-3-S Welder
Capacity .020″ to .080″ diameter.

Model J-4-S Welder
Capacity .040″ to .160″ diameter.
STEEL, STEEL ALLOYS,
AND THERMOCOUPLE WIRE.

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We'll be glad to show you what we mean. For information on superior high-carbon wire or cold rolled strip, write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

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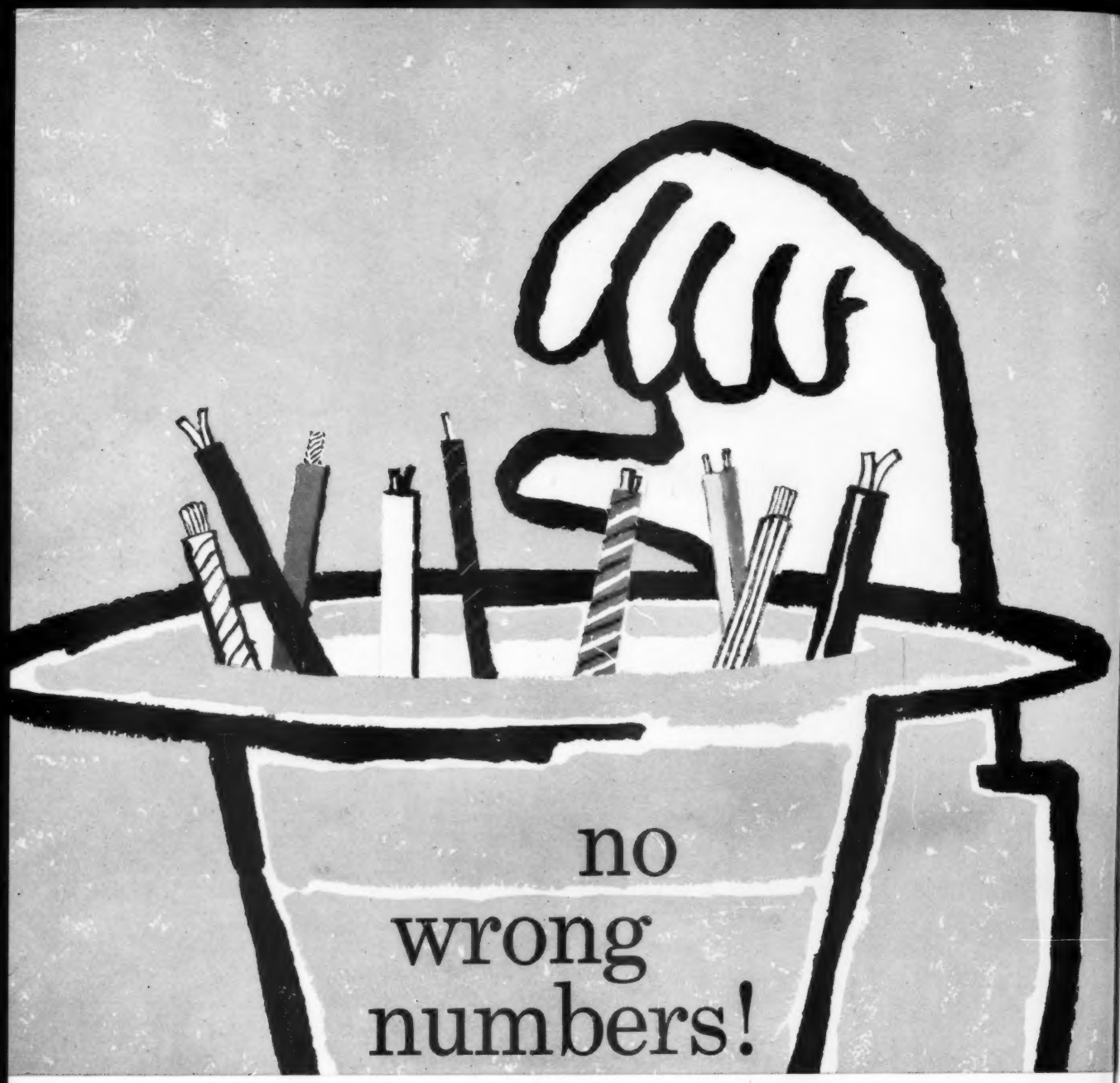
This lightweight "No Charge" spool is typical of Roebling's modern packaging methods that save customers time and money.



MONSANTO POLYETHYLENE formulations are based on long experience in supplying the specialized needs of the Wire and Cable Industry. That's why you can always count on a correct answer to your specific insulation problem, when you call Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.

*OPALON: REG. U.S. PAT. OFF.

Monsanto

MPE 10 medium molecular weight natural, with non-discoloring antioxidant; primary insulation for telephone cable, power cable, control cable, and general insulation use.

11302 medium molecular weight black, with non-discoloring antioxidant; for line and drop wire insulation, weather-resistant primary and support wire insulation, general purpose jacketing.

12203 high molecular weight natural, with non-discoloring antioxidant; primary insulation for telephone, power, and control cable; insulation requiring superior toughness, maximum stress crack resistance.

12253 medium molecular weight natural, with non-discoloring antioxidant; for primary insulation for coaxial cable, power cable, telephone cable, and general insulation use.

14202 high molecular weight black, with non-discoloring antioxidant; telephone and power cable jacketing; all jacketing and insulating applications requiring maximum stress crack and weather resistance.

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Your advertising in Wire and Wire Products will be seen by many people in the plants you wish to "sell", whom your salesmen never would see, yet who specify, actually buy or who influence decisions on products to be purchased. Your advertising is bound to be of immeasurable value to you, too, in paving the way for a good reception for your salesmen when they do call. And the field's buying power is tremendous!

WIRE AND WIRE PRODUCTS circulation is all paid. We have no agents, offer no premiums or make special inducements to get circulation, except the value of the editorial contents in itself—yet our renewals have averaged 97% *or better for many years. That's why it is* a good and forceful advertising medium for all concerns who have products to sell to this vigorous and progressive industry.

———— • ————

Subscribers by Types of Mills in the Industry

1.	Rod, Bar and Wire (producers of rod, bar and wire in all metals and shapes)	38%
2.	Forming and Fabricating Plants (mfrs., largely from purchased wire, of springs, wire cloth, bolts, nuts, screws, rivets, wire forms, fences and fencing, wire specialties, wire rope and electric wire and cable)	59%
3.	Miscellaneous—Libraries, Research Organizations, Jobbers, Distribution, etc.	3%

Subscribers by Types of Positions Held

1.	Executives: Presidents, Vice Presidents, Secretary-Treasurers, Purchasing Agents, Sales Managers	22%
2.	Operating: Vice Presidents, General Managers, Works Managers, Superintendents and Assistant Superintendents.	58%
3.	Research and Maintenance: Plant Engineers, Metallurgists, Laboratory Technicians, Foremen and Inspectors	19%
4.	Libraries	1%

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WORLD WIDE

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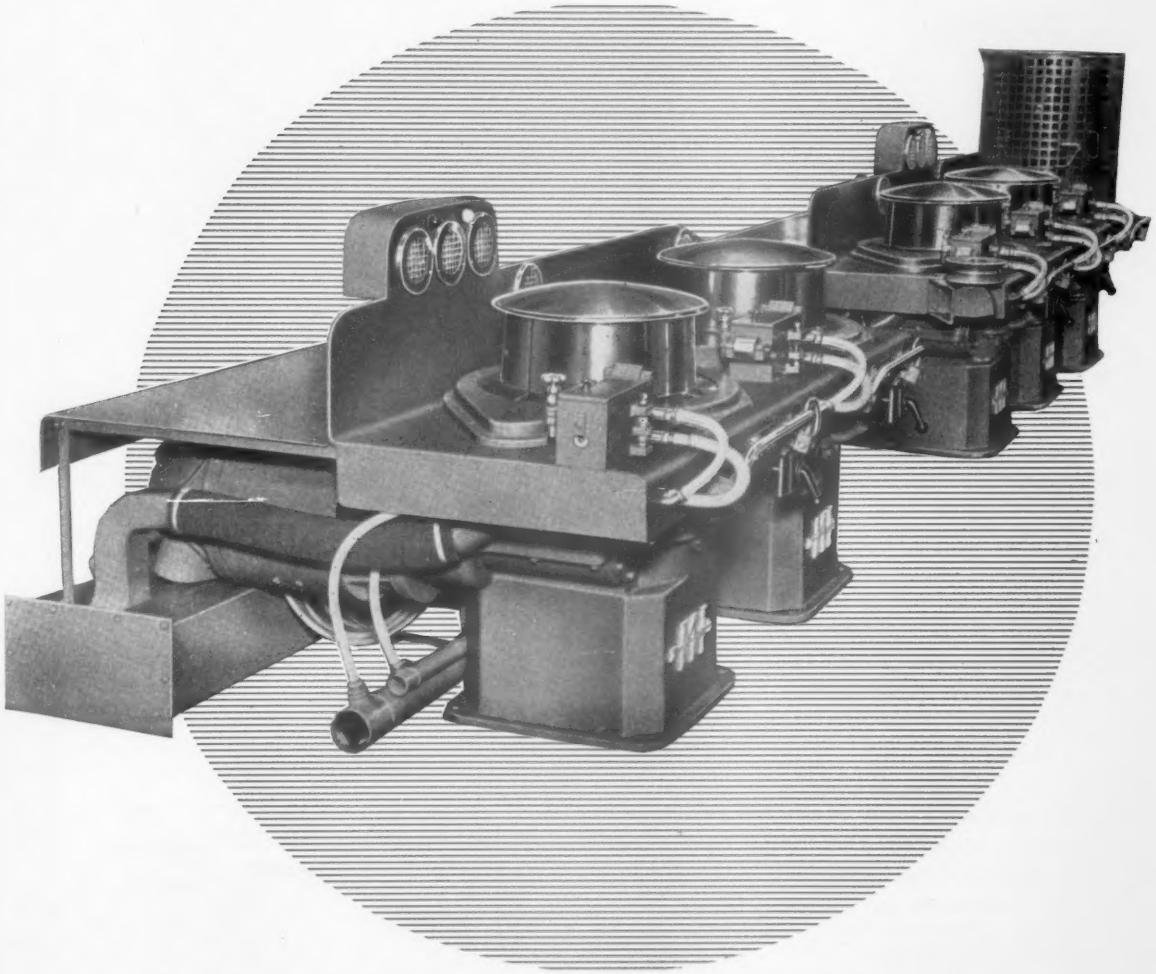

FOR GREATER FLEXIBILITY

This BEELINE DG-4 is designed and built to operate as two independent machines with two and three blocks OR as one machine with five blocks.

We pride ourselves in delivering complete machines, jobtested and ready to put into operation with a minimum of labor and installation expense.

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completed parts...

COLD HEADED

from wire!

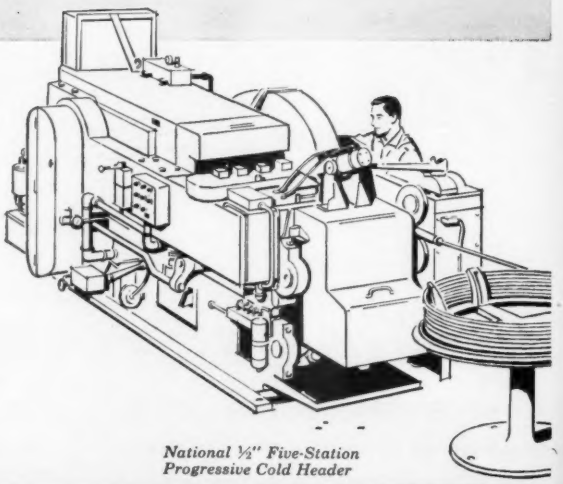
Top row, left to right: pipe plug, ball seat for push-rod end, splined square-head shaft. Middle row: commutator bar, solenoid contact, wire clamp. Bottom row: distributor cap insert, transistor case, spacer, link, distributor cap center wire insert.

All of the odd-shaped metal parts above were developed for fast, accurate production on National Cold Headers.

Complete and ready to use, these parts are made from wire, start-to-finish in one compact machine, at unbelievably high speeds with excellent die life, in most cases with no loss of material!

Production ranges from 40 parts per minute with stock of 1½" diameter up to 450 per minute in the ⅛" size. The jobs illustrated average 161 per minute.

Have you investigated Cold Heading? If you now have headers, have you considered widening your range and type of work to meet the growing requirements of metalworking?



National ½" Five-Station Progressive Cold Header

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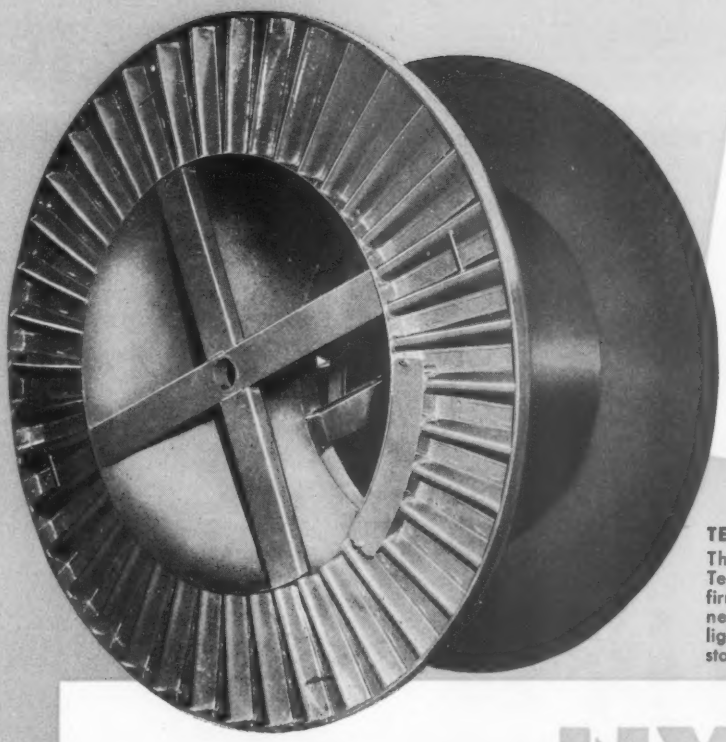

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March 9, 1959

New York Engineering Company
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Gentlemen:

We have tested your "NYECO" Light Weight Steel Reel, 78" x 48" x 36" traverse, Drawing Number 51015, and offer the following comment with reference to our Test Report:

ASSUMING A CONSERVATIVE SAFETY FACTOR OF 2 BASED UPON YIELD STRENGTH, IT IS OUR OPINION THAT THE CABLE REEL CAN BE SAFELY LOADED TO 16,650 LBS. WITHOUT DISTORTION.

Very truly yours,
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Roger Harvey
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TESTED AND APPROVED!
This letter from New York Testing Laboratories, Inc. confirms the superiority of the new NYECO smooth-faced, light weight steel reel over standard reels.

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greater protection against damage in shipping and processing with this rugged, weather-resistant, warp-proof, NYECO Steel Shipping Reel. All reels are furnished with four cross-arms unless otherwise specified. Drive-holes optional. No die charges or extras...any drum diameters or traverse. Flange diameters 42" to 90" inclusive.

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Send specifications for STEEL SHIPPING REELS, IMPREGNATING REELS, PROCESSING REELS, SUBMARINE CABLE REELS AND BRIDGE REELS. Prompt deliveries on large or small orders.

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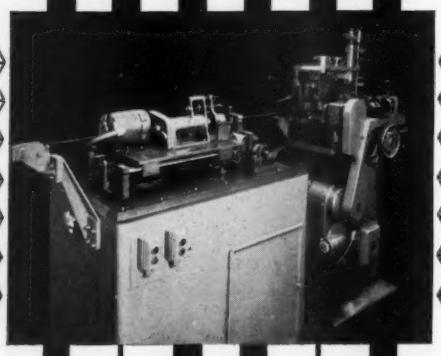

POOLED ENGINEERING PRODUCES NEW WIRE STRIPPING AND COILING MACHINE

The Problem Development of a high speed close tolerance method for producing nylon coated wire circuit breaker coils with pre-stripped ends for soldering. **The Attack** A cooperative program by the Rush Wire Stripper Division of The Eraser Company and Torrington Wire Forming engineers. **The Solution** Combining an intermittent stripper, the new Rush Model 2086 Wire Stripping Machine, and the Torrington W-3000 Torsion Winder. **The Technique** An electric stripping machine is placed between the payoff reel and the Torsion winder. As the winding head begins the recoil stroke, a signal from a cam-operated limit switch on the Torsion winder actuates the stripping mechanism. The machine is timed to strip only that portion of the wire which will appear on the ends of the finished coil. (If a 3/16" strip is needed on each end, the machine strips 3/8" at a time.)

The stripper consists essentially of a stripping head, a clamping device and a traveling table assembly. In the stripping head are mounted four knives which revolve about the wire at high speed and turn down the insulation to the depth desired. The clamping device holds the wire stationary while the table assembly carries the knives back along the wire line. The knives open automatically when the required length of wire has been stripped. The machine follows this sequence of operations: 1. Winding head begins recoil stroke. Wire is stationary. 2. Limit switch sends signal back to stripper. 3. Wire is clamped just forward of the stripping head. 4. Rotating knives bite into insulation. 5. Table assembly moves away from clamp. After required distance knives open. 6. Table assembly returns to original position, ready for next cycle.

Depending upon the length to be stripped, the machine can process upward of 60 circuit breaker coils a minute.

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Pittsburgh PX-120 DIDP

Pittsburgh PX-120 (DiIso Decyl Phthalate) offers you a unique combination of properties which make it especially suitable for the economical production of vinyl-jacketed electrical wiring.

PX-120 possesses excellent low-volatility, a prime consideration in vinyl wire insulation, especially where higher-than-normal temperatures are encountered. For additional retention of elongation on aging, Pittsburgh PX-120 can be supplied with Bisphenol A added.

Whatever your vinyl product, you can count on PX-120 for good permanence, resistance to extraction, and low temperature properties . . . plus a low specific gravity that enables you to enjoy appreciable economies on a pound-volume production basis.

May we acquaint you further with this versatile plasticizer? Write for samples and technical data.

PITTSBURGH *Job-Rated* PLASTICIZERS

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PX-120 DiIso Decyl Phthalate
PX-126 DiTri Decyl Phthalate
PX-138 DiOctyl Phthalate
PX-314 n-Octyl, n-Decyl Phthalate
PX-208 DiIsoOctyl Adipate
PX-212 n-Octyl, n-Decyl Adipate
PX-218 IsoOctyl Decyl Adipate
PX-220 DiIso Decyl Adipate
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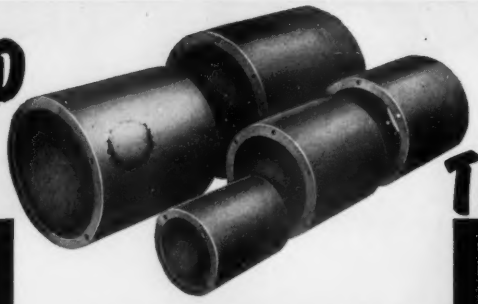
HUBBARD TRAVERSES



EASILY ASSEMBLED IN 4 RAPID STEPS TO SAVE COST AND TIME

1 PLACE BOLTS IN REEL HEAD

2 SET HEAD ON FLOOR, BOLTS UP

3 TRAVERSE POSITIONED ON WOODEN HEAD

4 TOP HEAD LAID ON TRAVERSE AND BOLTED DOWN

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The Wire Outlook

The costly and senseless steel strike may be over by virtue of the Taft-Hartley Law, but many differences still have to be composed and many adjustments to shortages must be made before American industry can feel that it is operating on an even keel.

During the shortage period great impetus has been given to steel importations. In the first seven months of 1959 steel product imports rose to 2,346,000 tons, although the tempo of imports was considerably accelerated during the period of the strike.

That, however, isn't the whole story. Because of labor's periodic insistence upon higher wages, imports have been climbing for a long time. In the decade ending in 1958 our steel exports dropped 37 percent from 4,300,000 tons to 2,700,000 tons, while imports rose from 300,000 tons to 1,700,000 tons — up 467 percent.

Our domestic wire manufacturers are seriously concerned, since 19 percent of the reinforcing bars, 32 percent of the wire nails and staples, and 52 percent of the barbed and twisted wire sold in this country in 1958 came in on foreign bottoms. It is estimated that this influx of imported steel products has cost labor about 35,000 jobs as a result. This is a cogent reason why the spiral of wage increases should be halted. Any increase now would provide an additional spur to inflation as well as be damaging to the economy.

Without doubt, the two greatest threats to American free enterprise are 1) the abuse of union power and 2) excessive government spending. Long years of deficit financing have created a precarious fiscal state in our national affairs that, in itself, is highly inflationary and unsound. Coupled with the continued waves of wage grants, an untenable situation has been created in our business relations with the rest of the world.

The United Steel Workers' leaders have evidenced a wanton disregard of the facts of life in their refusal to heed economic distress signals — a selfish obstinacy that rejects consideration of the national interests and the welfare of many they profess to represent.

The 80-day "cooling off" period is no assurance that the strike will not be resumed in January, but, of course, it is to be hoped it will not. Other strikes are in the offing, too, all of which could curb the national tendency toward greater prosperity.

To control the increased activity that is in prospect, the Federal Reserve Board is planning to make money even tighter. The credit situation is considered to have reached dangerous proportions — said to be the worst since 1920-21. It is unlikely, however, that the full effect of the curb in installment buying will be felt until late next year. It will affect the construction industry, too.

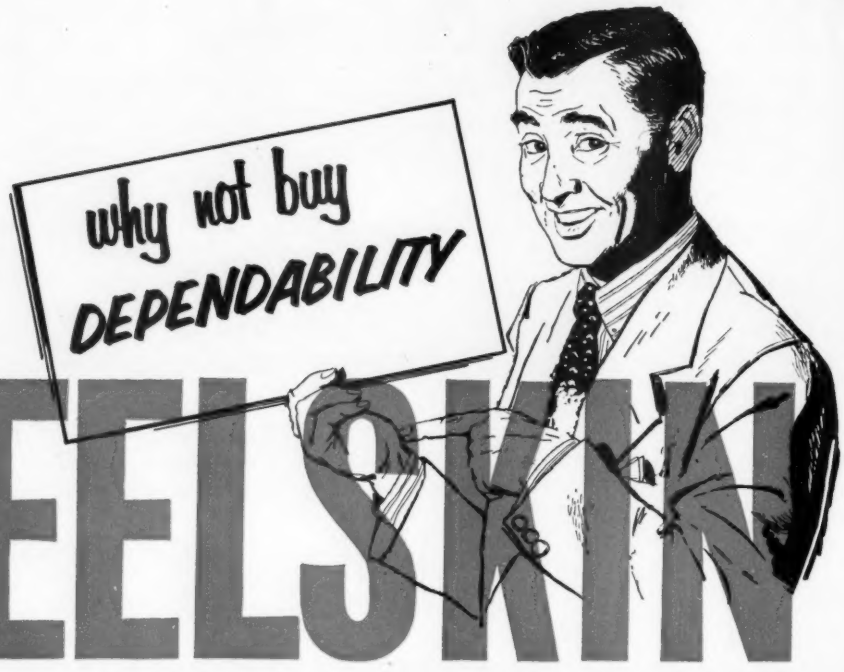
At the present time it looks as though there may be a strong rise in business late this year, attaining to boom proportions in the first quarter of 1960 and extending through the second quarter. By mid-year, there may be a leveling out at the new highs in most segments of industry. Toward the end of 1960 will come a testing period as the effects of tight money are felt and, as inventories again will be large, the situation should bear careful watching.

The wire ball is being carried mainly by the non-integrated mills, for while all integrated mills were not on strike, the great bulk were closed down. The independents stocked heavily before the strike and have been active. Cold heading wire is now in short supply and shortages have shown up in other quarters as stocks have become depleted. Orders are being accepted, but many cannot be scheduled until rod production gets rolling in the big mills.

Business should snap back fast now that the strike is over and output of goods will probably break previous records. Retail trade is expected to go to new highs and employment should rise strongly.

For the Christmas season, most enterprises should enjoy a gratifying volume of business.

Edmund Duval Sickels
EDITOR



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High Temperature Tests on Aircraft Control Cable

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Introduction

During World War II the Research and Development laboratory of the **John A. Roebling's Sons Corporation** made a study of aircraft control cables for the National Defense Research Committee, War Metallurgy Division. This work was concerned with the behavior of control cables operating under testing conditions designed to represent those experienced by Naval aircraft.

* * *

The primary investigation included a study of the fatigue properties of aircraft control cable under corrosive conditions and at temperatures between +160°F and —65°F. The results of this investigation were summarized in a report entitled "NDRC Research Project, NRC-15 Contract No. OEMsr-492".

* * *

In a relatively short space of time the development of supersonic aircraft has resulted in many new problems for the aircraft design engineer.

* * *

After the sound barrier was successfully penetrated, the speed of aircraft increased to such an extent that designers are now confronted with a heat barrier problem. The operating temperatures have increased with the speed of flight and designs now specify temperatures above 1000°F. The high temperatures are generated on the surface of the aircraft due to the air friction on the skin surface.

* * *

The relationship between the speed of aircraft and the air temperature is shown in Fig. 1[1] where data for sea level and at 50,000 ft. altitude are presented.

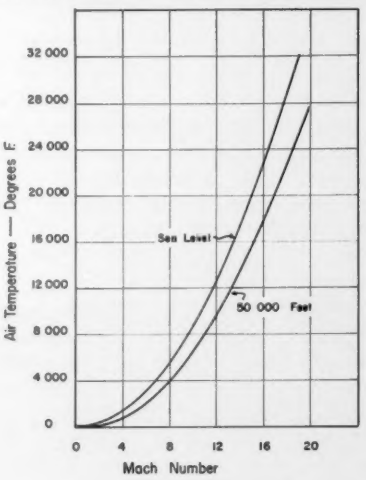

Fig. 1 Effect of Aircraft Speed on Air Temperature

The physical properties of metals are greatly affected by temperature and it was the purpose of this investigation to study the ef-

Howard J. Godfrey

Howard Godfrey graduated from Tufts College in 1931 with a degree of B.S. in Civil Engineering. He held a Research Fellowship at Lehigh University from 1931 through 1933 and graduated with an M.S. degree in Civil Engineering. From 1934 - 1937 he was a Research Engineer for the John A. Roebling's Sons Company. From 1937 to 1941 he served as Engineer of Tests at Lehigh University in the Fritz Engineering Laboratories. He rejoined Roebling in 1941 as a Development Engineer.

He presented this paper on October 13, 1959, at the Annual Convention of The Wire Association at Cleveland, Ohio.

(1) Westinghouse Engineer — March, 1959

fect of high temperatures on the properties of several types of aircraft control cables.

* * *

The program of testing to date has been somewhat limited in scope but work is continuing on new materials as they are developed. We believe these results will promote additional interest in this area of materials testing.

Test Methods

The tests were designed primarily to study the effect of high temperatures on the tensile, creep and fatigue properties of aircraft cables.

* * *

The tensile properties were determined on a 40,000 lb. Amsler hydraulic testing machine. A view of the testing machine with electric furnace in place, is shown in Fig. 2.

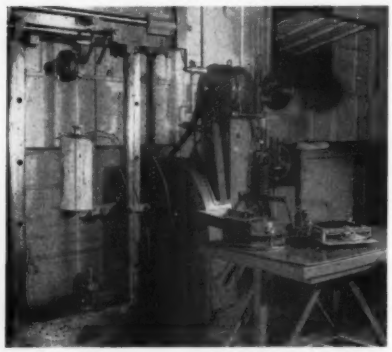

Fig. 2 — 40,000 lb. capacity Amsler testing machine with electric furnace. * * * *

The tensile specimens were held in the testing machine either by drum grips of by threaded swaged fittings. The dimensions of the test specimen with swaged fittings are shown in Fig. 3.

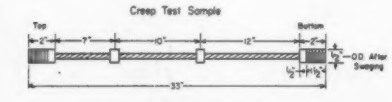

Fig. 3 Test Specimens for High Temperature Tensile and Creep Tests

The creep tests were made in a Tatnall creep testing machine, Model RL-6, illustrated in Fig. 4. The creep tests were made at a constant temperature and the amount of creep was measured with a 10" gage length extensometer.

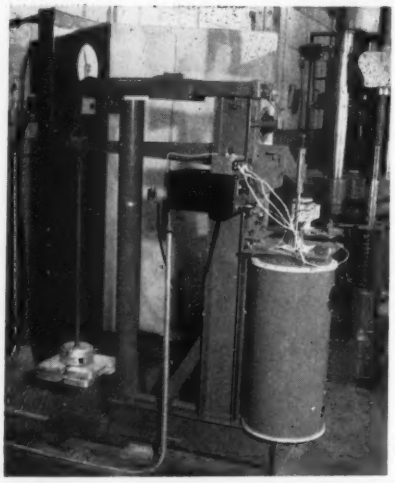

Fig. 4 — Tatnall high temperature creep testing machine, Model RL-6. * * * *

The creep test specimen is also shown in Fig. 3 which illustrates the stainless steel collars that were swaged on the test specimen to provide a suitable mounting for the extensometer.

* * *

The cable fatigue tests were made on a Warner type testing machine which incorporated a hydraulic loading system to maintain a constant cable tension as the cables were oscillated back and forth over hardened steel test pulleys.

* * *

A schematic diagram of the fatigue machine is shown in Fig. 5. The cables moved back and forth over test pulleys which had a root diameter 16 times the cable diameter. The cable tension was approximately 10% of the catalog strength of the cables.

After a preliminary study, the duration of the fatigue test was established at 10,000 cycles or 20,000 bends over the test pulley. Under these conditions the fatigue test lasted somewhat over 5 hours.

* * *

In order to heat the cables during the fatigue test an electric furnace one foot in length was placed on each side of the test pulley. The temperature of each furnace could be individually controlled. The cables moved in and out of the furnaces and for this reason it was necessary to maintain a furnace temperature considerably higher than the cable temperature.

* * *

As in the tensile and creep tests, chromel-alumel thermocouples were attached directly to the fatigue test specimens so that the cable temperature could be observed at all times. The thermocouples were placed on the fatigue specimens in such a position that at the end of each stroke one thermocouple would be adjacent to the test pulley. This procedure was found necessary since it was not possible to maintain a thermocouple in the section of cable passing over the test pulley.

* * *

Visual observations at red heat indicated that the thermocouples were not located at the point of maximum temperature. The point of maximum temperature was midway between the thermocouples and was approximately 10 per cent above the recorded temperature. All fatigue temperatures in this article refer to recorded temperatures and not maximum temperatures.

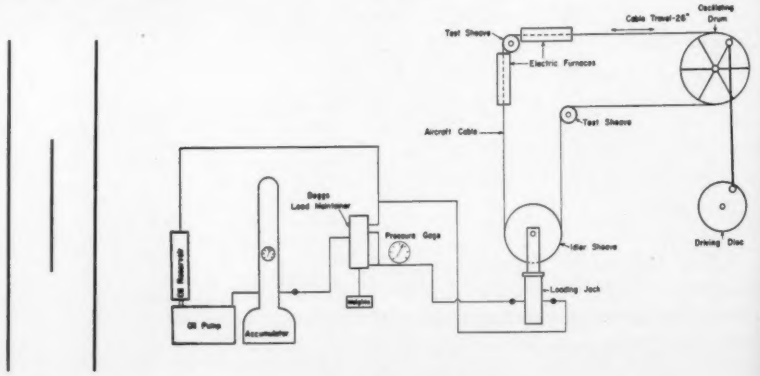

Fig. 5 Fatigue Testing Machine for Aircraft Cable

The fatigue test was started at room temperature and within the first 1,000 cycles the temperature was brought to the desired level. After a total of 9,000 cycles the heat was shut off and during the final 1,000 cycles the cables were allowed to cool.

* * *

At the completion of the fatigue test the tensile strength of the fatigued section of the cable was determined. The ratio of the final breaking strength to the original strength was used as a measure of the fatigue properties.

* * *

In some instances the cables failed before completing 10,000 cycles. The fatigue machine stopped automatically when a cable failed, and the number of cycles to failure was recorded.

* * *

Fig. 6 shows a view of the test pulley and heating furnaces on the fatigue machine.

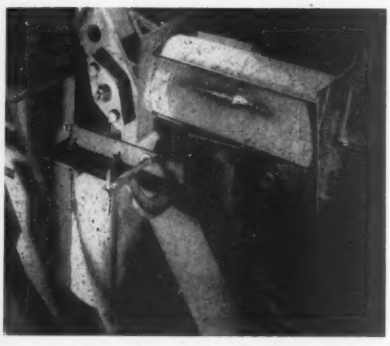

Fig. 6 — Test pulley and heating furnace on fatigue testing machine. * * * * * *

Materials

The following types of aircraft cables were included in the investigation:

* * *

5/32″ dia. 7x19 Preformed Galvanized Carbon Steel
5/32″ dia. 7x19 Preformed Type 304 Stainless Steel
1/8″ dia. 7x19 Preformed Type 17-7 PH Stainless Steel
1/4″ dia. 7x19 Preformed Type 316 Stainless Steel
5/32″ dia. 7x19 Preformed Inconel X
5/32″ dia. 7x19 Preformed A-286 Stainless Steel
5/32″ dia. 7x19 Preformed Titanium — A.S.T.M. B-265-52T-Grade 3

* * *

All of the above cables were fabricated from cold drawn wire which has a fibrous structure and not an equi-axed granular structure. The cables were tested as-manufactured and after special heat treatments which were designed to improve the tensile strength of the cables.

No special lubricants were used for the tests reported in this paper. A study of high temperature lubricants is in progress but considerably more work will be required before any general conclusions can be made.

Test Results

1. Tensile Properties

The breaking strengths of the following three types of 5/32″ diameter 7x19 aircraft cables at various temperatures are shown in Fig. 7:

5/32″ dia. Galvanized Carbon Steel
5/32″ dia. Type 304 Stainless
5/32″ dia. Inconel X

The data show that the galvanized Carbon steel had the highest breaking strength at room temperature but as the temperature increased above 400°F its breaking strength decreased very rapidly. At 700°F the breaking strength of the Carbon steel was only 55% of its room temperature strength.

* * *

The type 304 Stainless steel cable showed a definite decrease in strength at 300°F but maintained this strength level up to 900°F, at which temperature the strength was 75% of its room temperature strength. Above 900°F the breaking strength of the type 304 Stainless steel cable decreased rapidly.

* * *

The Inconel X cable had the lowest room temperature strength of the three cables included in Fig. 7 but maintained its strength up to a temperature of 1000°F, at which temperature the breaking strength was 95% of its room temperature strength. Above 1000°F the strength of the Inconel X cable decreased rapidly.

* * *

These data graphically illustrate the problem of designing for supersonic speeds which result in operating temperatures above 1000°F. It will be the assignment of the materials engineer to develop new metals that will extend

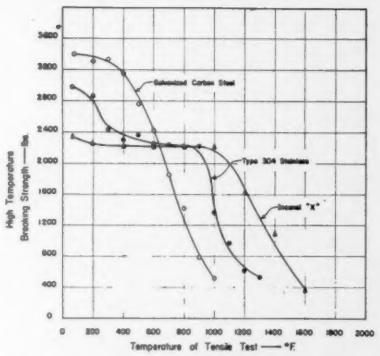

Fig 7 High Temperature Breaking Strength of Aircraft Control Cables
5/32" dia. Galvanized Carbon Steel
5/32" dia. Type 304 Stainless Steel
5/32" dia. Inconel-X

the safe operating range to higher and higher temperatures.

* * *

The high temperature service will require special alloy steels containing expensive elements. A comparison of the chemical analyses of the above three types of aircraft cable in Table I will illustrate the difference between the composition of plain carbon steels and heat-resistant steels.

TABLE I

Chemical Analyses of Aircraft Cables

	Carbon Steel	304 Stainless	Inconel X
Carbon	.80 max.	.08 max.	.04
Manganese	.60 max.	2.00 max.	.50
Silicon	.35 max.		.40
Chromium		18.0 to 20.0	15.0
Nickel		8.0 to 12.0	73.0
Columbium			1.0
Titanium			2.5
Iron	Remainder	Remainder	7.0
Aluminum			0.7

* * *

A preliminary study indicated that the room temperature strength of aircraft cables could be increased by certain heat treatments.

* * *

The effects of heating Inconel X and type A-286 Stainless steel aircraft cables at various temperatures in an air furnace are illustrated in Fig. 8. The maximum breaking strength at room temperature was obtained by heating the Inconel X cable to 1200°F for a one-hour heating period. The maximum breaking strength of the A-286 Stainless steel cable was obtained by heating one hour to 1000°F. In general the breaking strength at room temperature gradually increased with an increase in the heat treating temperature. Above an optimum temperature, however, the room temperature strength then de-

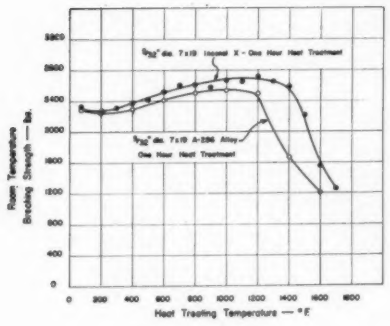
5/32" dia. 7x19 Inconel X - One Hour Heat Treatment
5/32" dia. 7x19 A-286 Alloy - One Hour Heat Treatment
Room Temperature Breaking Strength — lbs.
Heat Treating Temperature — °F

Fig. 8 The Effect of Heat Treating on the Room Temperature Breaking Strength of Aircraft Cables
5/32" dia. Inconel-X
5/32" dia. A-286 Stainless Steel

creased rapidly.

* * *

Similar data on type 316 Stainless steel aircraft cable are presented in Fig. 9, which shows that the maximum strength was obtained at about 900°F for a one-hour heat treatment.

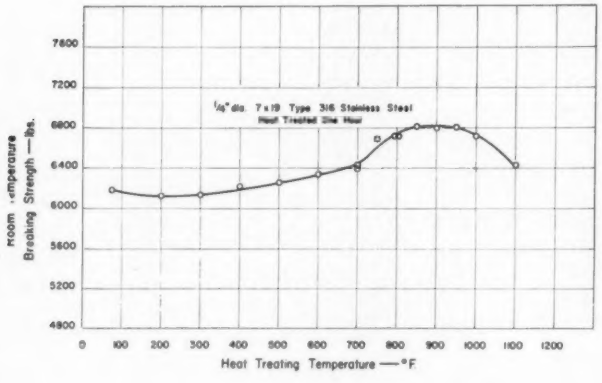
1/4" dia. 7x19 Type 316 Stainless Steel Heat Treated One Hour
Room Temperature Breaking Strength — lbs.
Heat Treating Temperature — °F

Fig. 9 The Effect of Heat Treating on the Room Temperature Breaking Strength of 1/4" dia. Type 316 Stainless Steel Aircraft Cable

The effects of heat treating 1/8" dia. 7x19, type 17-7 PH Stainless steel and 5/32" dia. 7x19 Titanium aircraft cable for one hour are shown in Fig. 10. The tensile

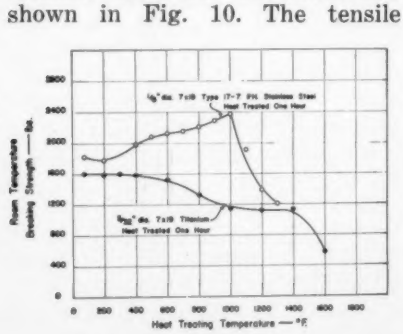
1/8" dia. 7x19 Type 17-7 PH Stainless Steel Heat Treated One Hour
5/32" dia. 7x19 Titanium Heat Treated One Hour
Room Temperature Breaking Strength — lbs.
Heat Treating Temperature — °F

Fig. 10 The Effect of Heat Treating on the Room Temperature Breaking Strength of Aircraft Cables
1/8" dia. Type 17-7 PH Stainless Steel
5/32" dia. Titanium

strength of the 17-7 PH cable at room temperature increased considerably as the heat treating temperature increased. After one hour at 1000°F the breaking strength was 2365 lbs. or 30% higher than its original strength.

* * *

The 5/32" diameter Titanium aircraft cable did not behave in the same manner as the previous material. The breaking strength of the Titanium cable decreased gradually with an increase in heat treating temperature up to 1400°F. Above 1400°F the room temperature strength decreased rapidly.

* * *

The effects of heat treating galvanized Carbon steel and type 304 Stainless steel aircraft cables are presented in Fig. 11. The heat treatments for these experiments were for a 5-hour period in an air furnace.

The galvanized Carbon steel aircraft cable maintained its room temperature strength up to about 400°F and then decreased considerably as the heat treating temperature increased.

* * *

The test results on the type 304 Stainless steel aircraft cable were quite different from those obtained on any of the other materials. As shown in Fig. 11, the room temperature strength reached a minimum value after heating 5 hours at a temperature between 250°F and 300°F. This phenomenon was not expected but fortunately provided an explanation of some irregular fatigue test results that were previously obtained on Type 304 Stainless steel.

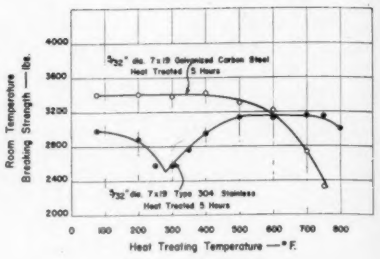
5/32" dia. 7x19 Galvanized Carbon Steel Heat Treated 5 Hours
5/32" dia. 7x19 Type 304 Stainless Heat Treated 5 Hours
Room Temperature Breaking Strength — lbs.
Heat Treating Temperature — °F

Fig. 11 The Effect of Heat Treating on the Room Temperature Breaking Strength of Aircraft Cables
5/32" dia. Galvanized Carbon Steel
5/32" dia. Type 304 Stainless Steel

* * *

The decrease in the room temperature strength of the Type 304 Stainless cable after heating in this critical temperature range may possibly be due to an embrittling effect caused by strain aging. The tensile strength of .010" dia. Type 304 Stainless steel wire did not behave in the same manner but showed a gradual increase in tensile strength with an increase in heat treating temperature up to 750°F.

* * *

The room temperature breaking strength of all materials except the galvanized Carbon steel and Titanium cables could be improved by a suitable heat treatment. However, when the tensile tests were conducted at high temperatures the improvement was not so significant, as illustrated in Fig. 12. This figure contains the results of high temperature tensile tests on heat treated and non-heat treated A-286 Stainless steel cables, and shows that the strength of both cables was the same at temperatures above 800°F. Below 800°F the heat treated cables had a higher breaking strength.

* * *

A comparison of the high temperature tensile strengths of some of the materials included in this investigation is presented in Fig. 13. The tensile strength in p. s. i. was computed from the breaking load and the cross-sectional area of the cables. In this manner the various sizes of cable could be related.

* * *

The data for the 1/4" type 316 Stainless steel cable were not included in Fig. 13 but the results were similar to the A-286 alloy cable up to a temperature of

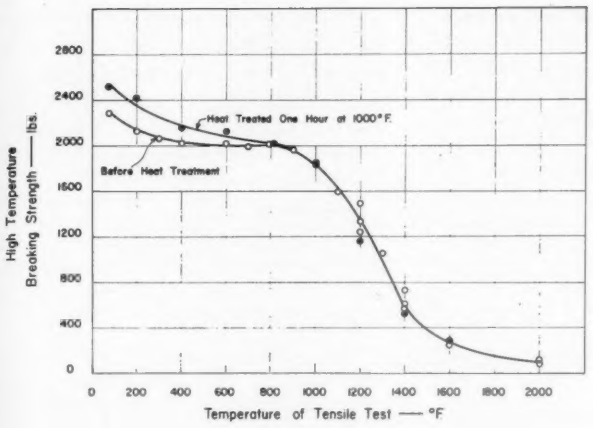
High Temperature Breaking Strength — lbs.
Heat Treated One Hour at 1000°F.
Before Heat Treatment
Temperature of Tensile Test — °F

Fig. 12 The Effect of Heat Treatment on the High Temperature Breaking Strength of 5/32" dia. A-286 Stainless Steel Aircraft Cable

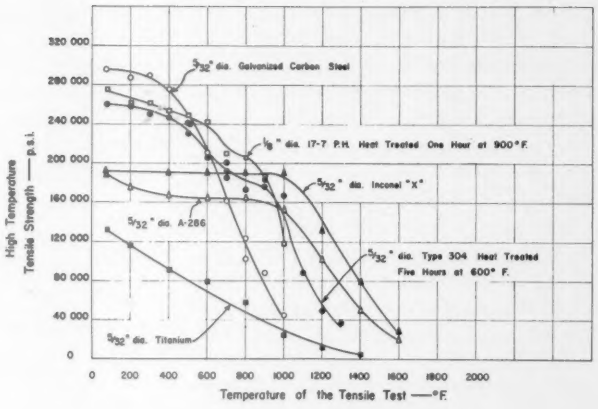
High Temperature Tensile Strength — p.s.i.
5/32" dia. Galvanized Carbon Steel
1/8" dia. 17-7 P.H. Heat Treated One Hour at 900°F.
5/32" dia. Inconel "X"
5/32" dia. A-286
5/32" dia. Type 304 Heat Treated Five Hours at 600° F.
5/32" dia. Titanium
Temperature of the Tensile Test — °F.

Fig. 13 High Temperature Tensile Strength of Aircraft Cables

1100°F, which was the highest testing temperature investigated for the Type 316 Stainless cable.

* * *

The comparison of the high temperature strengths indicates that all of the material investigated, with one exception, had higher strength properties above 700°F than galvanized Carbon steel cable. The tensile strength of the Titanium cable was lower than that of the galvanized Carbon steel cable from room temperature up to 1000°F.

* * *

The Inconel X cable had the highest tensile strength at temperatures above 1000°F. The problem of producing satisfactory aircraft control cables for operating temperatures above 1200°F is illustrated by these test results.

* * *

The chemical analyses of types A-286, 316 and 17-7 PH Stainless steel aircraft cables are presented in Table II.

TABLE II

Chemical Analyses of Aircraft Cables

	A-286 Alloy	Type 316 Stainless	Type 17-7 Stainless
Carbon	.08 max.	.08 max.	.07
Manganese	1.00 - 2.00		1.00 max.
Silicon	.040- 1.00		1.00 max.
Chromium	13.50 -16.00	16.0 - 18.0	17.0
Nickel	24.00 -27.00	10.0 - 14.0	7.0
Molybdenum	1.00 - 1.75	2.0 - 3.0	
Titanium	1.75 - 2.25		
Vanadium	.10 - .50		
Aluminum	0.35 max.		1.20

2. Creep Properties

The study of the creep properties at high temperatures was restricted due to the limited amount of testing equipment available.

* * *

The effect of prestressing on the high temperature creep properties of aircraft cable was investigated first, and the results of these tests are illustrated in Fig. 14. The 5/32" dia. type 304 Stainless steel cables were prestressed 5 times to a load of 1440 lbs. which is equivalent to 60% of the guaranteed strength. The prestressing was performed at room temperature.

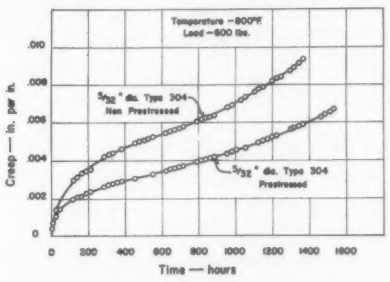

Fig. 14 The Effect of Prestressing on High Temperature Creep Properties of Type 304 Stainless Steel Aircraft Cable

The creep tests were conducted at 800°F under a load of 600 lbs. or 25% of the guaranteed breaking strength. The test results in Fig. 14 indicates that the prestressing operation considerably decreased the amount of creep. As a result of these tests and the fact that aircraft cables are prestressed prior to use, all of the following high temperature creep tests were conducted on prestressed cables.

* * *

The breaking strength of the 5/32" diameter type 304 Stainless steel cable at 800°F at the completion of the creep test was approximately the same as the original strength. The breaking strengths at 800°F were 2275 lbs. and 2300 lbs. for the non-prestressed and prestressed cables respectively, whereas the original strength of both materials was 2220 lbs. at 800°F.

* * *

The results of high temperature creep tests on prestressed Type 304 and Type A-286 Stainless steel and Inconel X aircraft cables are presented in Fig. 15. These tests were made at a temperature of 800°F and with a load of 600 lbs. Under these conditions the Inconel X and A-286 Stainless steel cables had considerably less creep than the Type 304 Stainless steel cable.

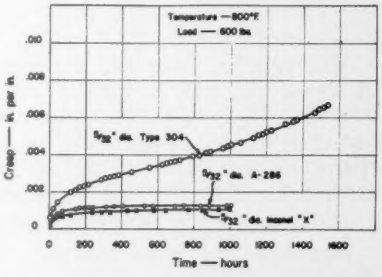

Fig. 15 High Temperature Creep Test on Prestressed Aircraft Cables
5/32" dia. Type 304 Stainless Steel
5/32" dia. Type A-286 Stainless Steel
5/32" dia. Inconel - X

* * *

After 1500 hours the Type 304 Stainless continued to creep at an increasing rate, whereas the A-286 and Inconel X cables were apparently stable after less than 1000 hours.

* * *

The breaking strength at 800°F

after the creep test was 2325 lbs. and 2035 lbs. for the 5/32" diameter Inconel X and A-286 Stainless steel cables respectively. The corresponding breaking strengths before the creep test were 2210 lbs. for the Inconel X and 2015 lbs. for the A-286 Stainless steel.

* * *

The creep properties of the Inconel X material was investigated at three temperature levels and the results are presented in Fig. 16. The amount of creep increased with temperature and at 1200°F the rate of creep was so high that the specimen fractured after only 87 hours. After 1200 hours the creep at 1000°F on the Inconel X cable was approximately the same as the creep on the Type 304 Stainless steel cable at 800°F. However, at 1200 hours the rate of creep on the Type 304 Stainless cable at 800° F was greater than that of the Inconel X cable at 1000°F.

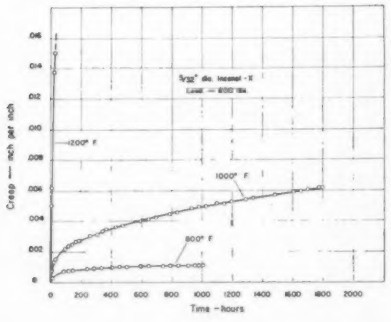

Fig. 16 High Temperature Creep Tests on 5/32" dia. Prestressed Inconel - X Aircraft Cables

The original breaking strength of the 5/32" dia. Inconel X cable at 1000°F was 2200 lbs. The strength of the Inconel X cable at the same temperature after the creep test at 1000°F was 2315 lbs.

* * *

The effect of heat treating on the creep properties of 5/32" dia. A-286 Stainless steel cable was also investigated and the results are presented in Fig. 17. The heat treatment at 1000°F for 1 hour, increased the room-temperature breaking-strength of the A-286 cable from 2280 lbs. to 2540 lbs. or about 11.5%. After 1000 hours under a 600 lb. load at 800°F the amount of creep in the heat treated cable was only about 60% of the original material. Although the breaking strength of both materials at 800°F was the same (shown previously in Fig. 12), the creep properties were apparently improved by the heat treatment. Both of these materials were prestressed prior to making the high temperature creep tests.

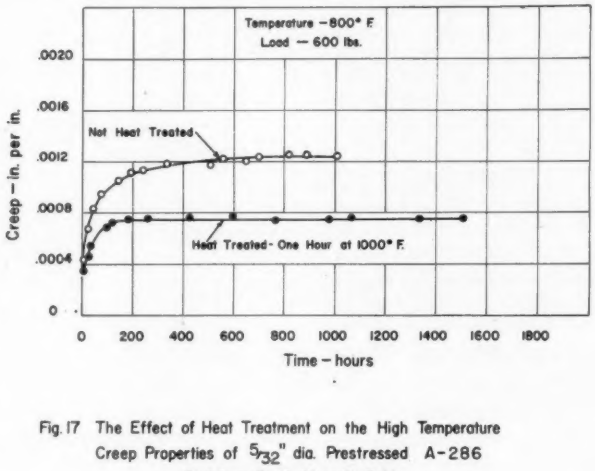

Fig. 17 The Effect of Heat Treatment on the High Temperature Creep Properties of 5/32" dia. Prestressed A-286 Stainless Steel Aircraft Cable

The creep properties of Titanium and type 304 Stainless steel aircraft cables at 800°F are illustrated in Fig. 18. The load on the Titanium cable was only 50% of the load on the type 304 Stainless cable and even under these conditions the creep of the Titanium cable greatly exceeded that of the type 304 material.

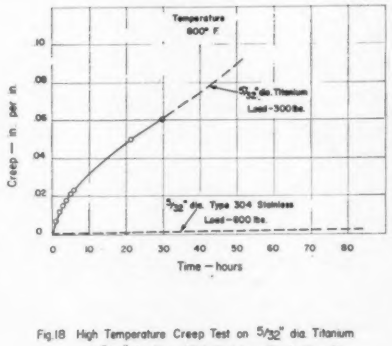

Fig. 18 High Temperature Creep Test on 5/32" dia. Titanium and 5/32" dia. Type 304 Stainless Steel Aircraft Cables - Prestressed

The breaking strengths and the strength-density ratios of the Titanium and type 304 Stainless cables are presented in Table III. In all cases the comparison is made on non-heat treated materials. The Inconel X and A-286 Stainless material are included for comparison.

* * *

Table III shows that the strength-density ratio of the Titanium cable at room temperature was about the same as the type 304 Stainless cable, and 30% higher than the Inconel X cable. At 800°F, however, the Titanium strength-density ratio was considerably less than the other materials.

TABLE III

Breaking Strength and Strength-Density Ratios of 5/32" Dia. Aircraft Cables

Type	Temp. °F	Breaking Strength lbs.	Strength-Density Ratios
Titanium	Room	1610	355
304 Stainless	"	2980	376
A-286 Stainless	"	2280	278
Inconel X	"	2330	274
Titanium	400°	1110	244
304 Stainless	"	2300	290
A-286 Stainless	"	2025	247
Inconel X	"	2220	261
Titanium	800°	705	155
304 Stainless	"	2220	280
A-286 Stainless	"	2015	246
Inconel X	"	2210	260
Titanium	1200°	140	31
304 Stainless	"	620	78
A-286 Stainless	"	1300	158
Inconel X	"	1620	190

At 800°F the strength-density ratios of the type 304 Stainless and Inconel X cables were approximately the same, but at 1200°F the Inconel X cable was considerably higher.

* * *

The strength-density ratio of the A-286 Stainless was slightly below that of the type 304 Stainless in the intermediate temperature range, but was superior to the type 304 Stainless at 1200°F.

* * *

3. Fatigue Properties

The results of fatigue tests on 5/32" dia. galvanized Carbon steel aircraft cable are presented in

Table IV.

TABLE IV

Fatigue Tests on 5/32" Dia. Galvanized Carbon Steel Aircraft Cable

Cable Tension - 10%
Pulley Ratio - 16X

Recorded Temperature of Fatigue Test *	Room Temperature Breaking Strength-lbs. Before Fatigue	After Fatigue	
800°F	3420	0	Failed after 12,048 reversals
800°F	3420	0	" " 3,008 "
800°F	3420	0	" " 3,540 "

* Actual Fatigue Temperature approximately 10% higher.

All of the galvanized Carbon steel cables failed to complete the 20,000 reversals on the fatigue machine at the 800°F temperature.

* * *

The results of fatigue tests on 5/32" diameter, type 304 Stainless steel aircraft cables are presented in Table V.

TABLE V

Fatigue Tests on 5/32" Dia.
Type 304 Stainless Steel Aircraft Cable

Cable Tension - 10%
Pulley Ratio - 16X

Recorded Temperature of Fatigue Test ♦	Room Temperature Breaking Strength-lbs. Before Fatigue	After Fatigue	%
800°F	2980	2690*	90.2
800°F	2980	2600*	87.1
800°F	2980	2580*	86.5
800°F	2980	2640*	88.5

* Failed outside fatigue section.
♦ Actual Fatigue Temperature approximately 10% higher.

The above tests indicated that the Type 304 Stainless cable lost over 10% of its original strength due to the high temperature fatigue test. However, it was observed that the cables fractured in the tensile test at a section of the test specimen which had not been over the test pulley and contained no wire breaks. The fatigued section of cable contained several wire breaks.

* * *

The apparent weak section of the cables was at a point one inch inside the furnace when the fatigue machine was at the end of its stroke. An investigation showed the temperature of the cable at this section reached 260°F during the 800°F fatigue test. Referring to Fig. 11 we find that after heating the type 304 Stainless cable for 5 hours in the temperature range 250-300°F, the room temperature strength decreased from 2980 to 2580 pounds, or about 13.5%. Fig. 11 also shows that after heating 5 hours at 800°F, the room temperature breaking strength of the type 304 Stainless steel was equal to its original strength.

* * *

The results of this study showed, therefore, that the loss in strength due to heating at 260°F during the fatigue test was greater than the effect of the fatigue test at 800°F.

* * *

Additional fatigue tests at 800°F were made on the type 304 Stainless steel cable. The tensile tests after fatigue were made in such a manner that only that part of the specimen which operated over the pulley was within the test length. The results of these tests were as follows:

Room Temperature Breaking Strength After 800°F Fatigue Test	*Percent of Original Strength*
2830 lbs.	95.0
2915 lbs.	98.0
2980 lbs.	100.0
2935 lbs.	98.5

* * *

The above tests indicate that the loss in room temperature strength due to fatigue at 800°F was a maximum of 5%, which is considerably less than the 13.5% loss due to heating in the critical temperature range.

* * *

The experimental heat-treatments illustrated in Fig. 11 also indicated that the breaking strength of type 304 Stainless cable could be increased to a maximum by heating 5 hours at 600°F. Samples of cable were heat-treated in this manner and then tested in fatigue at 800°F. The results of fatigue tests on the heat-treated and non-heat-treated cables are presented in Table VI.

The above tests show that the heat treated cable lost only 2.5% of its original strength after the fatigue test at 800°F and indicate that heat treating the type 304 Stainless cable eliminated the critical temperature range.

* * *

Additional high temperature fatigue tests were made on a new lot of heat treated 5/32" dia. type 304 Stainless steel cable. In these tests the temperature was increased to a level at which the cable failed during the fatigue test.

TABLE VI

Fatigue Tests on 5/32" Dia.
Type 304 Stainless Steel Aircraft Cable

Cable Tension - 10%
Pulley Ratio - 16X
Recorded Temp. - 800°F. ♦

Condition	Room Temperature Breaking Strength-lbs. Before Fatigue	After Fatigue	%
Not Heat-treated	2980	2550*	85.6
Heated 5 hrs. @ 600°F	3100	3030**	97.5

* Fractured outside fatigue section.
** Fractured within fatigue section.
♦ Actual Fatigue Temperature approximately 10% higher.

* * *

The results of the fatigue tests are presented in Table VII along with similar results on other types of aircraft cable. The data in Table VII compares the room temperature breaking strength before and after the fatigue test at elevated temperatures.

* * *

The fatigue tests on the heat treated type 304 Stainless steel cable indicated that the fatigue life was seriously reduced when the fatigue temperature exceeded 850°F.

* * *

The quanity of 17-7 PH and type 316 cable was limited and the high temperature tests were restricted to the 800°F temperature. The 1/8" 17-7 PH lost an average of 3% of its strength after the fatigue test. The type 316 Stainless and Inconel X steel cables also showed little loss of strength after the 800°F temperature fatigue test.

* * *

Another series of high temperature fatigue tests, presented in Table VIII, was made on several types of cables, in which the tensile strength of the cables was determined at the same temperature as the fatigue test. The ratio of these two values indicates the effect of the fatigue test on the high temperature breaking strength.

The data in Table VIII showed that the high temperature fatigue

TABLE VII

High Temperature Fatigue Tests on Aircraft Cables

Cable Tension - 10%
Pulley Ratio - 16X

Material	Recorded Room Temperature Temp.of Fatigue Test °F♦	Breaking Strength-lbs. Before Fatigue	After Fatigue	Strength Ratio %
5/32" Type 304 Stainless Heat-treated 5 hrs. @ 600°F	800	3200	2980	93.0
"	800	3200	2905	91.0
"	850	3200	2910	91.0
"	850	3200	2950	92.0
"	900	3200	failed after 17,740 reversals	
"	1000	3200	failed after 4,640 "	
1/8" Type 17-7 PH Stainless Heat-treated 1 hr. @ 900°F	800	2290	2175	95.0
"	800	2290	2240	98.0
"	800	2290	2275	99.5
"	800	2290	2195	95.5
1/4" Type 316 Stainless	800	6300	6220	98.8
1/4" Type 316 Stainless Heat-treated 1 hr. @ 900°F	800	6800	6180	91.0
5/32" Inconel X	800	2330	2340	100.0
"	800	2330	2330	100.0
5/32" Inconel X Heat-treated 1 hr. @ 1200°F	800	2720	2730	100.0
"	800	2720	2520	92.5

♦ Actual Fatigue Temperature approximately 10% higher.

properties of the Type 304 Stainless steel cable were not satisfactory above 850°F.

* * *

The high temperature fatigue life of the Inconel X cable decreased very rapidly at temperatures above 1000°F.

* * *

Similar tests were made on the A-286 Stainless steel aircraft cable before and after heat treating. The results of these tests are shown graphically in Fig. 19 and Fig. 20. These results show that above 900°F the fatigue test seriously affected the breaking strength of the A-286 Stainless steel cable.

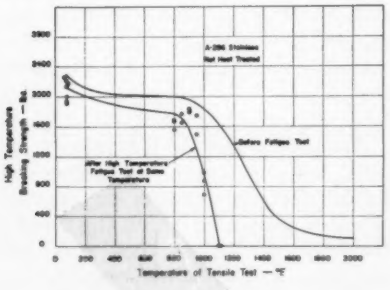
A-286 Stainless Not Heat Treated
Before Fatigue Test
After High Temperature Fatigue Test at Room Temperature
High Temperature Breaking Strength — lbs.
Temperature of Tensile Test — °F

Fig.19 High Temperature Breaking Strength of 5/32" dia. A-286 Stainless Steel Aircraft Cable before and after High Temperature Fatigue Test at a Corresponding♦ Temperature

♦Actual Fatigue Temperature Approximately 10% Higher

Summary

The number of tests completed to date on the properties of aircraft control cables at high temperature were so limited that no general conclusions could be established. However, the results were very informative, and based on the testing conditions investigated, the data indicated the following:

* * *

Galvanized carbon steel cables were not satisfactory for operating at 800°F.

* * *

Austenitic type stainless steel cables performed relatively well at temperatures up to 800°F.

TABLE VIII

High Temperature Fatigue Tests on Aircraft Cables

Cable Tension - 10%
Pulley Ratio - 16X

Material	Temp. of Tensile & Fatigue Test, °F♦	High Temperature Breaking Strength-lbs. Before Fatigue	After Fatigue	Strength Ratio-%
5/32" Type 304 Stainless	800	2225	2180	98.0
5/32" Type 304 Stainless Heat-treated 5 hrs. @ 600°F	800	2250	2190	97.0
"	800	2390	2340	98.0
"	800	2390	2380	99.5
"	850	2150	2460	114.0
"	850	2150	2375	111.0
"	900	failed after 17,740 reversals		
"	1000	" " 4,640 "		
1/4" Type 316 Stainless	800	4800	4420	92.0
"	800	4800	4330	90.0
1/4" Type 316 Stainless Heat-treated 1 hr. @ 900°F	800	4300	3840	89.5
"	800	4300	4170	97.0
5/32" Inconel X	800	2210	2330	106.0
"	800	2210	2160	97.5
"	1000	2150	1785	83.0
"	1000	2150	1765	82.0
"	1100	1700	770	45.3
"	1100	1700	665	39.1
"	1100	failed after 14,080 reversals		
"	1100	" " 14,348 "		
5/32" Inconel X Heat-treated 1 hr. @ 1200°F	800	2340	2365	101.0
"	800	2340	2355	100.5
"	1000	2150	2105	98.0
"	1000	2150	2065	96.0
"	1100	1700	880	52.0
"	1100	1700	950	56.0
"	1100	failed after 6,610 reversals		
"	1100	" " 16,390 "		

♦ Actual Fatigue Temperature approximately 10% higher.

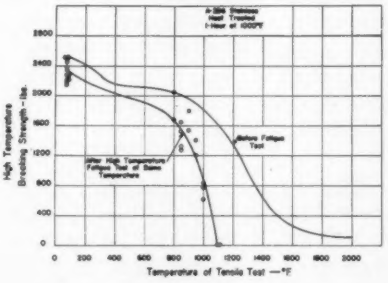
A-286 Stainless Heat Treated 1 Hour at 1800°F
Before Fatigue Test
After High Temperature Fatigue Test at Room Temperature
High Temperature Breaking Strength - lbs.
Temperature of Tensile Test — °F

Fig.20 High Temperature Breaking Strength of Heat Treated 5/32" dia. A-286 Stainless Steel Aircraft Cable before and after High Temperature Fatigue Test at a Corresponding♦ Temperature

♦Actual Fatigue Temperature Approximately 10 % Higher

The Inconel X cable was the best material at temperatures above 800°F.

* * *

The problem of supplying a satisfactory aircraft control cable for temperatures above 1000°F has yet to be solved. The test program is being continued and new materials will be investigated as soon as they are available. One of these materials is Type 15-7 Mo. Stainless Steel Cable, which may have some advantages over similar steels at high temperatures.

Acknowledgements

We wish to thank **Mr. A. J. Morgan,** Product Engineer of the Wire Rope and Aircord Division of the John A. Roebling's Sons Division, for his advice and continued interest in this program of tests. We also wish to express our thanks to **Mr. H. W. Berglund,** Supervisor of the Physical Testing Laboratory, Research and Development, for conducting the experimental tests.

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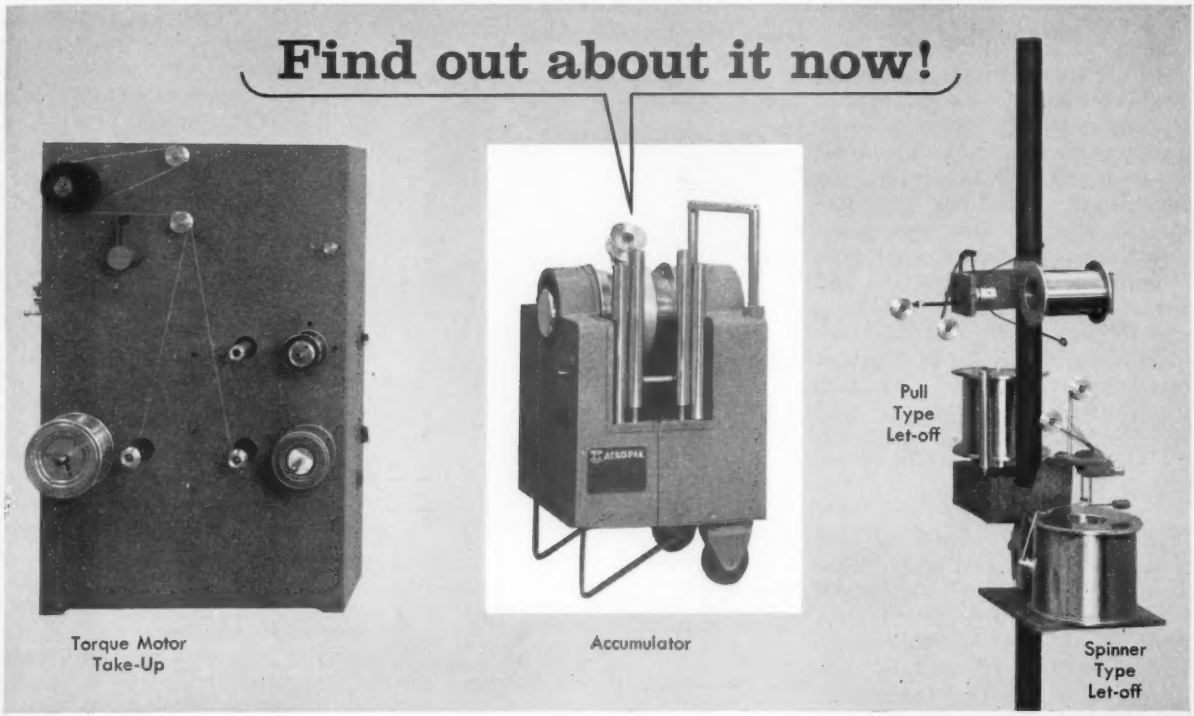

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Thin Metal Strips for Sheathing Telephone Communication Cables

by H. N. Padowicz
Senior Staff Engineer, Cable Development
Western Electric Company
Kearny, New Jersey

Introduction

Bell System telephone cables have been covered with lead sheath for many decades in order to maintain them free of moisture under all conditions and to protect the transmission conductors from mechanical damage. On several occasions possible acute shortages of lead due to quantity and chemical composition considerations threatened the manufacture of lead sheathed cables by **Western Electric Company** for the Bell System. This dependence on lead was eliminated by the development of a telephone cable sheath to replace or supplement lead.

* * *

The postwar shortage of lead accelerated, into actuality, new concepts of cable sheath designs to cover telephone communication cables. Composite sheath constructions of thin metals, cements, elastomers, and plastic compounds were developed for this use. Conjunctively, manufacturing techniques, new to cable sheath technology, to continuously flood, form, solder, and apply these coverings were developed to produce the desired cable sheath in a tandem sequence of synchronized progressive operations.

H. N. Padowicz

The author, a graduate Chemical Engineer of Rensselaer Polytechnic Institute and a Licensed Professional Engineer in New Jersey, has been with Western Electric Company since 1937. He has duties in connection with wire drawing, plastic molding, and development of cable and composite plastic — thin metal sheaths.

Mr. Padowicz presented this paper at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 13, 1959.

Telephone Cable Sheath Designs

About 97 per cent of the telephone cable manufactured by Western Electric for Outside Plant use is Exchange Area Cable. This type is used to connect the subscriber's premises to local exchanges and local exchanges to each other and toll exchanges. New composite sheaths for Exchange Area Cable, well-known as Alpeth and Stalpeth, now constitute almost the entire Western Electric production with small amounts of about 5 per cent of lead sheath being produced for special situations.

* * *

This talk will only concern the thin metal strip components of the Alpeth and Stalpeth cables which are manufactured in large quantities at Western Electric (Fig. 1).

Fig. 1A

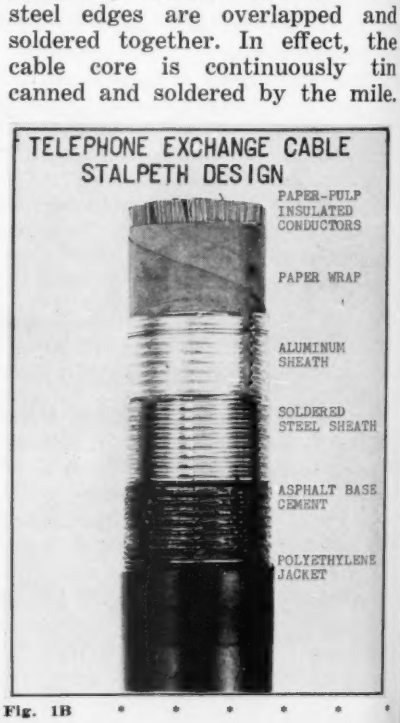


Fig. 1B

Alpeth sheath is used to cover polyethylene insulated conductor cores (PIC). In the present Alpeth design a rubber-polyester laminated tape is applied, longitudinally overlapped, directly over the cable core. This is covered with a longitudinal overlapped layer of thin aluminum strip either flat or corrugated and then enveloped with an extruded polyethylene jacket. This latter plastic covering prevents the ingress of water in liquid form and provides mechanical and corrosional protection.

* * *

Stalpeth sheath covers the pulp and paper insulated cores. It protects these against moisture infiltration and maintains the dryness of the conductor insulation. Stalpeth consists of a longitudinal nonoverlapping layer of aluminum for electrical purposes and a metal barrier for moisture infiltration. This latter covering is provided by a .007 inch thick tin or terne coated steel strip, corrugated and applied over the aluminum and intimately meshed therewith. The steel edges are overlapped and soldered together. In effect, the cable core is continuously tin canned and soldered by the mile.

Three metals—aluminum, steel, and solder—in sheet and strip form are used to fabricate the composite sheaths to meet the moisture infiltration, mechanical, and electrical sheath functions. Corrosion is not a requisite factor for the metal coverings since the metal envelopes are protected by the flooding compound and the polyethylene jacket.

Aluminum

General

Aluminum provides the electrical sheath functions as lightning protection and shielding to inductive interference effects in both Alpeth and Stalpeth sheaths. It also furnishes some mechanical protection in Alpeth to bending and crushing. Flat aluminum strip in the small Stalpeth cables also performs an additional function as a thermal diffuser of the soldering heat to protect and prevent scorching of the paper covered core. Aluminum was selected because of its availability and its physical and electrical properties. The gauge of .008 inch was determined by the necessary longitudinal resistivity for lightning protection and shielding. The Bell System's 50 years' experience with lead sheath had evaluated these factors and the thickness of aluminum was chosen on this basis.

Specifications and Physical Properties

Flat aluminum sheet, .008 inch thick, of the specified widths in coils, alloy 990A, temper "O" per ASTM-B-209 and a Western Electric Material Specification, is required in tight wound coils. Tensile and elongation physicals of 15,500 psi maximum and 15 per cent minimum respectively are specified. Composition and chemical requirements are per ASTM-B-209.

* * *

The corrugating and forming operations to fold the aluminum sheet around the cable core require a dead soft "O" temper. The faying edges of the longitudinal lap seam must be held down in close conjuction without springback to prevent these edges from protruding through the covering polyethylene jacket at the extrusion temperature. The "O" temper minimizes this effect. The best fatigue and bending properties of the aluminum envelope have been obtained with the "O" temper.

* * *

Surface appearance is secondary and a regular mill finish is acceptable. Prevention of layer sticking on pay-off is most important and the annealing of the coils is controlled to achieve this end. A slick or a dry annealed surface is satisfactory when spot welding is used for the splicing of the coil ends. A cold weld splicing for this same purpose requires a clean dry annealed surface. Recent advances indicate that ultrasonic welding may also be used for this application. Splices are rated satisfactory when holes are torn in the material before the welds give way when the overlapping edges are pulled apart.

Coils

The aluminum coils (about 10,000 feet of flat strip) are wound to 36 inches +0 —2 inches outside diameter on 4-inch standard black iron pipe cores. These latter units provide coil support and pay-off centers. Mill splices are made by our suppliers to obtain the specified coil size. The mechanical condition of the coils is very important for continuous trouble-free mass production on the sheathing lines (Fig. 2). Here, square, tight-wound, mill spliced, uniform large outside diameter coils are essential. Clean, undamaged coil faces and free, unwinding layers which do not tear are most important.

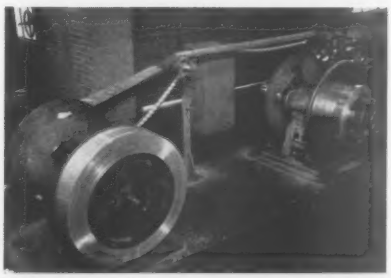


Figure 2

Packaging and Handling

The aluminum coils are vertically packaged in corrugated cardboard containers designed by Western Electric to protect the coils and facilitate handling. A special "C" hook picks up the aluminum coil hub and indexes into the slotted pay-off arbor. This package permits transfer of the coil from the container to the pay-off arbor in one step to minimize coil damage and smashed corner edges which are likely to occur in an upending operation. Our packaging was designed for maximum coil protection, ease of handling, and ease of storage.

* * *

In general, the application of aluminum sheet to Alpeth and Stalpeth does not require difficult properties of the material. The physical, chemical, and surface requirements are well within commercial tolerances.

Steel

General

The development of a manufacturing process for the composite cable sheath established that an essentially moisture and gastight soldered seam could be produced commercially by the induction heating method. Its chief disadvantage was slow speeed on the non-ferrous metals due to the poor heating effect of these low resistance metals. To improve this situation, steel was tried, giving at once a high speed soldering process.

* * *

Tin plate or terne plate of .007 inch gauge forms the moisture infiltration barrier which is the most important function of this covering. It also adds mechanical strength to the Stalpeth to increase its resistance to crushing, bending, and fatigue. These properties surpass the previous results obtained with lead sheath. Initially, a commercial, thin, solderable, coated steel strip to meet our requirements was not available. A .005 inch strip for this purpose was developed in collaboration with the suppliers, the specialty cold strip mills. Only hot wiped terne coatings were then available. These were inconsistent and difficult to control for thickness. Molten coatings applied with wiper pads are dammed up and wiped off with the exception of a thin film wetting the strip. No partial removal of the molten coating to arrive at a thickness greater than the wetting film was possible. The preparation and cleanliness of the

steel strip surfaces before it entered the coating tank was the most important factor. Electroplated terne coatings, unfused, were later developed by one supplier with satifactory results. Another supplier developed a mechanical cleaning method in conjunction with a hot wiped coating to also produce a satisfactory product.

* * *

Several years later, several large integrated tin plate mills developed, in collaboration with Western Electric, a suitable .007 inch tin plate sheet, the softest temper and thinnest gauge tin plate made at that time. These properties incur shop techniques, fabricating problems, and material shrinkages which are more critical on this material than those encountered with the conventional heavier tin plate. This material replaced the .005 inch steel strip. Terne plate strip, .007 inch, is also being produced now with a satisfactory hot wiped terne coating for this application.

Steel Base and Temper

The steel base for electrolytic tin plate is the commercial low carbon rimmed or modified cap grade that is normally supplied to the tin can industry. Aluminum killed steel can also be used if it is commercially available. The steel base for the terne plate is an aluminum killed steel in order to eliminate the rapid age hardening effect produced in rimmed steel by passage of the strip through a hot wipe bath. Better forming properties and uniformity of the terne plate result with the use of this material.

* * *

The softest temper of the steel sheet and strip commercially available is specified. This is T-1 or low T-2 for tin plate made by the integrated tin mills and T-5 for the terne plate which is made by the specialty strip mills. The lowest temper that can be practically processed in the above mill facilities is specified. The tin plate is given a very light temper pass to flatten and stiffen it for the subsequent tin plating operation. The terne plate is furnished in the fully annealed state since it can be processed in the narrow strip widths by the specialty strip mills. The exact transverse and registered longitudinal fits for the soldered joint are obtained by a stretch-forming operation, which sets the seam edges without springback to the desired position for soldering. This end result requires a soft uniform temper. The steel must uniformly fold around the forming tube without a V break. The corrugating operation cold works the steel strip to produce the uniform mechanical properties and physical characteristics required for forming. It eliminates the varying yield point and tendency to stretcher strain found in fully annealed low carbon steel. It also minimizes the effects of the non-uniformities caused by age hardening.

Solderability and Coatings

The solderability of the tin plate and terne plate must be satisfactory to obtain the continuous tight soldered joint of adequate strength necessary for the sealing of the steel covering. This property is requisite for the desired end result. Solderability is evaluated by a hot dip test (Fig. 3). Specimens of the tin plate or

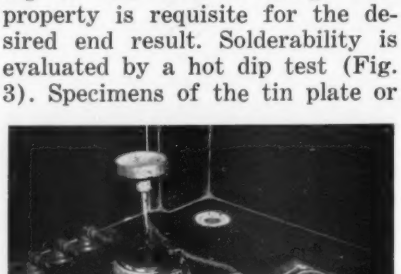


Figure 3

terne plate edges are immersed for five seconds in a molten 30 tin-70 lead solder bath maintained at 550°F. Rosin is placed on the surface of the molten solder. The rosin serves as a flux, reduces dross formation, and aids in the detection of bare spots. The specimens are removed and observed for wetting of the strip surfaces. Figure 4 shows the sample with typical acceptable A and B and nonacceptable C and D specimens. After an investigation of the numerous solderability tests used by the tin can, tin plate, and communication equipment industries,

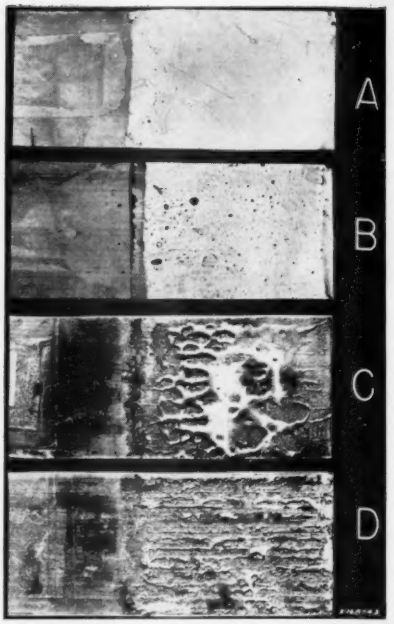


Figure 4

the above was selected for its excellent correlation to our actual manufacturing requirements. It has been used to rate thousands of tons of terne and tin plate.

* * *

The bonding of the joint faying surfaces to the steel strip base requires a uniform, even wetted surface. Surfaces with "dewetted" and bare areas will not make a suitable joint. The molten rosin of the solderability test will adhere to such areas to indicate this condition. A solderable tin or terne coating which is completely bonded to a clean steel surface is needed for good results. In our soldering operation, there is a critical sequence of a high heat input in a matter of one second into a localized area astride the seam which must be immediately solder joined to prevent burning of the soldering coating.

* * *

The purpose of the coating is primarily for solderability and secondly for storage shelf life. Hot wiped and electroplated tin and terne coatings are satisfactory. The desired electroplated tin or terne coating thickness per side is .00003 inch. Hot wiped coating thicknesses are heavier and more variable than the electroplated type. This coating thickness permits a reasonable manufacturing margin of safety. If it is too thin,

it may burn off without reflowing before the joint is soldered. Both unfused and reflowed electroplated and hot wiped tin and terne coating have been used in large quantity. These all met our solderability test and produced good manufacturing results. The application of these various coatings has been determined by the equipment and processes available at our several suppliers. Poor solderability is usually due to steel surfaces which have not been adequately chemically or mechanically cleaned preparatory to coating. The solderable film in these cases will dewet on the application of the soldering heat.

Surface

The surface appearance of terne and tin plate is of secondary importance to that of the solderability requirement. Fine scratches, texture, brightness, unfused electroplated surfaces, and satin finish are all acceptable contingent on these meeting the solderability requirement. Unfused electroplated terne coatings only have been used. A satin finished tin plate made by unpolished rolls on the temper roll step to produce better roll traction and tin plate uniformity for the light reduction made in this operation is used in large quantity. In general the surface produced has been contingent on the supplier's facilities and processes. These are acceptable if the solderability is satisfactory.

Oiling, Shelf Life, and Corrosion

The tin plate and terne plate are oiled during slitting with SAE-10 mineral oil to lubricate the corrugating and forming operations. The most economical rust protection of the slit coils is obtained by oiling the steel strip and producing a tight-wound coil. A safe, short-term life for at least one year is secured. Under severe storage and shipping conditions, VPI (a rust inhibitor) paper liners on the raw slit coil faces are recommended. We have found that this light mineral oil without inhibitors will aid the soldering operation. It vaporizes before the soldering heat is attained and protects the steel surface to this stage.

* * *

Chloride fluxes are used to prepare the steel strip surfaces for the hot wiped tin and terne coatings. All traces of these chlorides must be removed by thorough washing. Slight detectable chloride residues will accelerate rusting and deterioration of the coated steel strip during storage.

Defects — Common Commercial

The steel strip is produced in coil form and it is only practical to inspect the coil ends. The quality of tin plate and terne plate has been good and the percentage of rejections in coils has been about .3 per cent. Occasional defects are found inside the coils and only appear during manufacturing. These are detected by the steel strip alarm and the hole detectors. The common defects are missed tin mill splices from the pickling, rolling, and tinning operations, which were not cut out on final coiling. These areas are usually overgauge, matte appearance, and have scalloped edges. Holes, cracks, and inclusions are present to a small degree. Some defects originate in slitting. These are narrow and varying widths, ridges and scored sheet, stretched center, buckled and rolled over edges. Non-solderable areas are caused by interruptions during the plating process. Inadequately cleaned and dirty steel surfaces are always discolored or bare (untinned).

Coil Size and Packaging

The desired coil size for tin plate and terne plate will be contingent on the supplier and the in-plant facilities. The largest coil size now being handled at Western is about 200-250 pounds per inch width and about 2,000 pounds maximum weight for one 8¼ inch wide coil. (Fig. 5). This size requires mill splicing equipment at the slitter and steel skids for shipping as the cardboard container will not safely support these large coils. Corrugated cardboard containers will package a 135 pound per inch width coil or about 1,100 pounds maximum weight for a 8¼ inch wide coil. We stack these cardboard containers and steel skids three high.

* * *

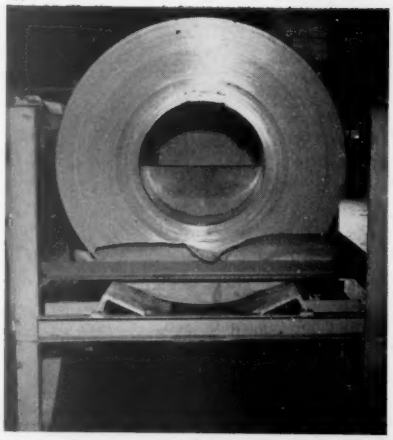


Figure 5 * * * * * * * * * * *

Hard, tight, self-supporting 16 inch inside diameter open center steel coils are required. These coils may require steel band cores or wood blocks for support against collapse if self-supporting coils are not produced in the slitting operation.

Solder

General

A tin-lead alloy solder joins the lap seam in the steel covering to seal this moisture infiltration barrier and to form a closed corrugated tube for the mechanical strength of Stalpeth. In the early development work, molten solder was pumped on the outside of the registered lap seam which was heated by a special gas burner device. The molten solder then moved into the joint by capillary action. High frequency induction heating simultaneous with the closing of the seam edges under pressure was later developed for this application. The soldering could now be best accomplished by pre-positioning the solder strip inside the longitudinal lap seam and by melting it in place. This sequence is shown in Fig. 6. This soldering operation is also more amenable to the control desirable for a manufacturing operation.

* * *

Fluxing of the seam faying surfaces and the molten solder is required to prepare these for effective joining. A non-corrosive flux, rosin, is imperative to prevent destructive corrosion of the cable sheath. The application of the

(*Please turn to page* 1548)

ABC of Better Lubrication and Cooling in Steel Wire Drawing

by Dr. J. George Wistreich
Head of Mechanical Working Division
The British Iron & Steel Research Association
Sheffield, England

As the demand for ever higher finishing speeds continues unabated, the tasks of maintaining satisfactory physical properties of the wire and of preserving the dies in the interests of high machine efficiency, are getting beyond the scope of traditional methods and marginal improvements. It seems desirable, therefore, to re-examine the nature of the problems by going back to fundamentals, so as to get a better 'leverage' on obstacles encountered. This thought has inspired the British Iron and Steel Research Association's work on lubrication and cooling, which has proceeded in three phases, concerned respectively with happenings within the die; the development of thick-film lubrication; and, most recently, with the extraction of heat from the wire. As a result of this work we believe that we have hit on practical and economic means of drawing steel wire much faster than at present.

* * *

The purpose of this paper is to give a thumb-nail sketch of these developments against the background of fundamental knowledge gained.

Conditions in the Die

The first facts brought to light by laboratory experiments exceeded the worst expectations. We found that the pressure between wire and die can average from, say, 70,000 p.s.i. for soft mild steel to over 600,000 p.s.i. for hard-drawn high-carbon steel. As for temperature, we have on record a mean temperature in the die-throat of over 750°F, when single-holing well lubricated 0.100 in. mild steel wire at 3,000 ft./min.; others, experimenting with 0.2 in. high-carbon steel wire found that the temperature, averaged over the entire working face of the die, topped 500°F at speeds as low as 100 ft./min., and this was going up roughly with the cube root of the speed.

Dr. J. George Wistreich

Mr. Wistreich joined The British Iron & Steel Research Association in 1946 as Scientific Officer charged with the initiation of wire drawing research. Although he has held various posts in the Association since then, culminating in his present appointment, his responsibility for the wire drawing research has continued uninterrupted. In 1959 the degree of doctor of engineering science was conferred on him by the University of London for his research work in metallurgical engineering.

He presented this paper on October 13, 1959, at the Annual Convention of The Wire Association in Cleveland, Ohio.

* * *

On the strength of these figures, it was hard to understand how any lubricant could get into the die, other than an invisable string of molecules chemically bonded to the wire surface and why rope wire does not get red hot when drawn fast. Further experiments solved the puzzle and became the starting point of new developments in lubrication and cooling. These will now be described in turn.

Towards Better Lubrication

As the result of these subsequent investigations, we now know that normally the lubrication in dry drawing is what the specialists call 'quasi-hydrodynamic'. The meaning of this and its implications can be appreciated from the following analogy. Let us picture an overloaded hydro-plane, fitted with skids instead of floats, trying to take off from a lake that is nearly dried up and has a stony bed. When stationary, the plane rests on the bed; as it gathers speed, the skids rise to the water surface and may even leave the surface temporarily, but not sufficiently to clear the larger stones sticking out here and there; owing to impacts with the stones, it keeps on dropping back onto the water surface and never becomes truly airborne. Any further opening of the engine throttle merely makes the bumps against protruding stones more violent.

* * *

In this analogy, the seaplane represents the die, the bed of the lake the wire, the small amount of water present the lubricant boundary layer (the motions of wire and die are reversed). That this is not too far-fetched a picture, is borne out by Fig. 1, which contains instrument records of the electrical resistance of the lubricant film between wire and die during fast drawing, suggesting the continual attempts to get the plane airborne; and of an autoradiograph of wire drawn through a radio-active die, providing evidence of the damage from repeated 'bumps' against the 'stony bed of the lake'.

* * *

The prevailing trend in wire lubrication is to coat the wire with ever more complex chemically

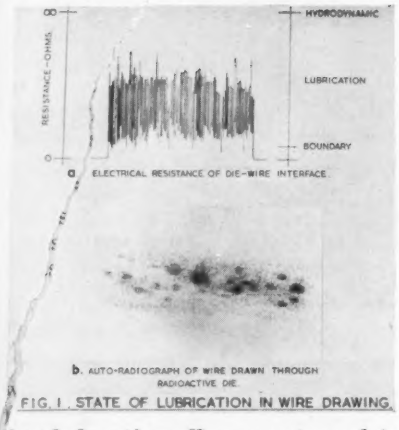


FIG. 1. STATE OF LUBRICATION IN WIRE DRAWING.

bonded anti-scuffing agents and to employ ever harder soaps. In terms of our hydroplane analogy, this amounts to 'rubberising' the lake bed, so as to reduce the damage to the skids, and substituting denser gases for the air over the lake, so as to enhance the aerodynamic wing lift. The 'rubberising of the stones' is an excellent idea, except that as speeds go up one finds it ever more difficult to build sufficient shock-absorption capacity into the 'rubber'. Likewise, the 'dense gas' gets hotted up by skin friction of the 'wings' and thus loses some of its extra 'lifting' capacity.

* * *

One is forced to conclude that improvement of wire lubrication along conventional lines will become increasingly difficult, because these do not strike at the root cause of the problem which is, — in terms of our analogy, — insufficient 'lifting capacity'. Now, bearing in mind the take-off conditions, the best cure would be to fit the plane with vertical take-off jets, that is to say to convert it into a 'hovercraft'. This is precisely the line we took up about wire lubrication, once its true mechanism became apparent to us. The aim which we set ourselves was to force the lubricant into the die under pressure.

Professor Christopherson's Invention

The idea is good, but as the pressures are in the 100,000 p.s.i. range, one doubts whether we would have got anywhere, had not Professor Christopherson, — an authority on hydrodynamic lubrication who had become acquainted with the wire problem about this time, — hit on the ingenious idea of using the wire as its own high-pressure oil pump. (In terms of our hydroplane analogy, instead of fitting take-off jets, he greatly enlarged the wings). His apparatus is shown in Fig. 2. The passage of the leader wire through the tube caused the oil to pile up against the die throat and, by the time the full-sized wire reached the die, the oil pressure there exceeded 40,000 p.s.i. Not only did this pressure prove sufficient to maintain an oil film in the die about 0.0003-in. thick, but even allowed some of the reduction of the wire to be accomplished in the tube.

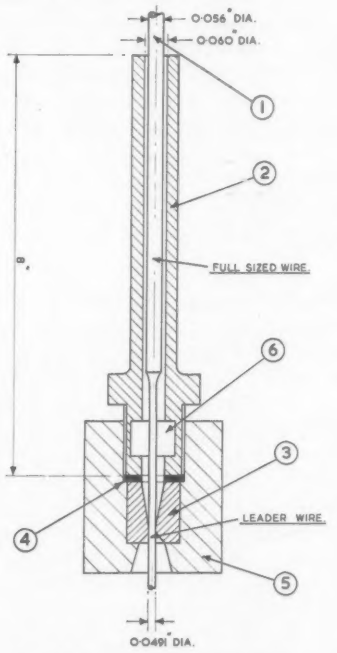


FIG. 2. TYPICAL ARRANGEMENT OF AN OIL PRESSURE TUBE AND DIE.

1. WIRE.
2. PRESSURE TUBE.
3. DIE.
4. HIGH PRESSURE SEAL.
5. DIE HOLDER.
6. OIL RESERVOIR.

The snag with this scheme is bad lubrication when starting and stopping. Indeed, in the absence of a 'leader' wire, the odds are against the lubrication ever becoming hydrodynamic, because the die gets overheated and takes the body out of the oil.

B.I.S.R.A. "Three in-one" Unit

In following up Christopherson's invention, we therefore switched from oil to dip-coating the wire with wax or soap. We eliminated thereby the starting problem, achieved films up to 0.002 in. thick and, incidentally, shortened the tube from Christopherson's 8 ins. to less than 1 in.

* * *

Subsequently, we combined the Christopherson principle with the wire drawer's traditional method of compacting dry soap on the wire by means of a nozzle, and constructed the three-stage device shown in Fig. 3. In the first stage, the soap powder picked up by the wire from the soapbox is compacted and, with the help of frictional heat and pressure, is turned into a pitch-like fluid; in the second stage, the pressure of this fluid is built up to 60,000 p.s.i. or more; and in the third stage, the wire is reduced in cross-section, the wire and die faces being separated by a film from 0.0005 to 0.002 in. thick, depending on requirements. Experienced wire mill men will be struck by the resemblance between the BISRA unit and the so-called 'pressure die'. Perhaps the most significant difference between the two is the absence of excess soap return passages in the BISRA unit. Indeed, as is seen in Fig. 3, a special seal is employed in the form of a tapered mild steel washer, to contain the much higher pressures developed; failure to fit the washer has caused experimental units to be blown apart. (The relief passages shown in Fig. 3 prevent such damage from occurring if the washer accidentally fails.)

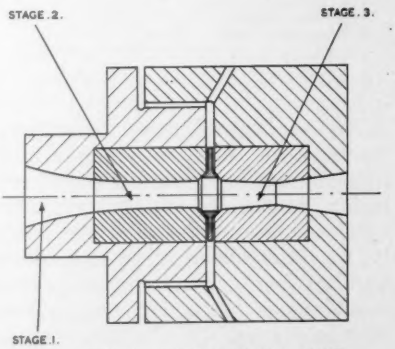


FIG. 3. BISRA. 3-IN-1 UNIT.

Basic Facts about Forced Lubrication

From research into the fundamentals of forced lubrication, we reckon that it functions as shown

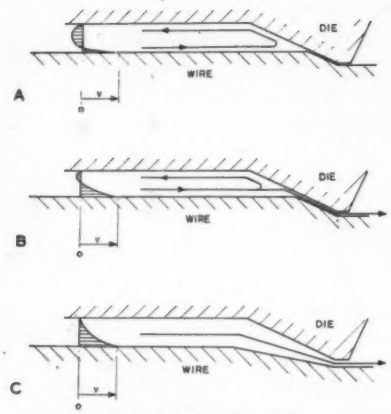


FIG. 4. FLOW PATTERNS IN FORCED LUBRICATION (IDEALIZED).

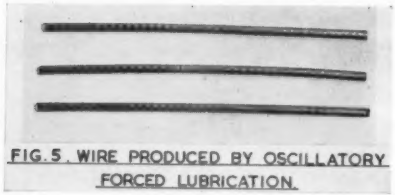


FIG. 5. WIRE PRODUCED BY OSCILLATORY FORCED LUBRICATION.

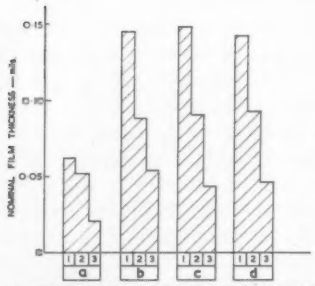


FIG. 6. COMPARISON OF FOUR METAL STEARATES.

EXPERIMENTAL CONDITIONS: HARD WIRE, DIAMETER 0·116 IN., 30 PERCENT REDUCTION, DIE INCLINED 6°, NOZZLE 1 IN. BY 0·040 IN., WATER COOLED TO APPROXIMATELY 100°C.

1. INLET SPEED 140 FT/MIN.
2. INLET SPEED 350 FT/MIN.
3. INLET SPEED 700 FT/MIN.

GRAIN	COARSE	FINE	
METAL RADICAL	BARIUM	CALCIUM	SODIUM
[illegible] ACID	b	c	d
[illegible] ACID	a	—	—

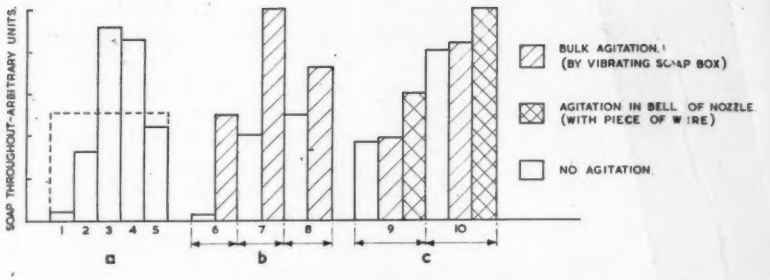


FIG. 7. FEED OF SOAP POWDERS.

a. EFFECT OF PARTICLE SIZE ON FLOW OF SOAP POWDER.

1. > 10 MESH } COARSE.
2. 10 to 20 MESH
3. 20 to 30 MESH } MEDIUM.
4. 30 to 40 MESH
5. < 40 MESH FINE.
----- AS RECEIVED.

b. EFFECT OF WIRE SURFACE AND BULK AGITATION ON FEED OF SOAP POWDER.

6. PICKLED AND DRIED WIRE.
7. LIMED WIRE.
8. SOAPED AND PREDRAWN WIRE.

C. DEPENDENCE OF FLOW OF SOAP ON METHOD OF AGITATION.

9. > 10 MESH
10. 10 to 20 MESH.

in Fig. 4. Depending on reduction, strength of wire, die angle and tube dimensions, and on the rheological properties of lubricant, the lubrication may be of type A or B; or it has been known to oscillate between type C and A, as the consequence of which the drawn wire is shaped like a bamboo shoot, with up to 0.005 in. difference between the 'waists' and ridges (see Fig. 5). Type A flow is prevalent in 'pressure' dies of the type used in some American mills; type B represents the optimum performance of the 'three-in-one' unit; the oscillatory flow is, at present, no more than a laboratory curiosity. Film thickness and maximum pressure are approximately proportional to the length of the parallel bore divided by the square of the radial clearance; but the smaller the clearance, the lower the speed at which type A flow takes over from type B.

* * *

Performance depends a great deal on the type of soap, as illustrated by Fig. 6. Compound soaps are better than soaps of pure acids even if the latter have a higher melting point. The important property seems to be the initial viscosity of the soap when fluid, and how fast it falls off with speed. The soap particle size also plays a part, presumably with regard to pick-up by the wire and freedom from clogging in the bell; some of the effects of particle size and of agitation are shown in Fig. 7.

* * *

As the research is not yet complete, it would be premature to state general design rules. However, for the sake of concreteness, the following are data of a scheme of well-proven high performance: ripper hole of 4 to 6-hole machines drawing M.S. rod with 250-500 ft./min. machine inlet speed; hard calcium soap with built-in 20-40% excess lime, particle size within 10-40 mesh; water-cooled BISRA unit having inlet bore ¾ in., bell radius 4", parallel bore 0.270 — 0.280 in., parallel length ½ in.; die taper 4°, die parallel nil (blended).

* * *

The unit has had extensive industrial trials with results illustrated by the following examples :-

1. **Wire Mill A drew mechanically descaled, mild steel rod, from 5 to 14 S.W.G. in 4 holes, finishing at 1,000 ft./min.; die life improved from 60 long tons to 450 long tons per die set, by fitting one BISRA unit in the ripper hole.**
2. **In Mill B drawing '50' carbon high quality wire on a seven-holer finishing at 1650 ft./min., the BISRA unit, fitted on the first hole only, doubled the average life of Nos. 1 and 2 and trebled the life of the remainder of the set.**
3. **In mill C drawing uncoated stainless steel rod one hole, the unit improved die performance more than twenty times.**

* * *

Particular attention is drawn to the fact that one unit on the ripper hole improves lubrication all along the line. It has also been found that die ringing is negligible, thus greatly easing the load on the die shop. The unit, if well cooled, has proved particularly successful with mechanically descaled rod.

* * *

As a result of these trials, done two to three years ago, the use of the BISRA unit, or of home-made 'pressure dies', is becoming wide-spread in British mills. The 'pressure dies' are similar to those in use in some U.S. mills, either with or without relief passages. Although the pressure build-up in these is very much less than in the '3-in-1' unit (in the order of 1,000 p.s.i.), the smaller improvement of lubrication is often adequate; the pressure dies are simpler to make and to service. They are to the '3-in-1' unit, what the Ford model T is to the Rolls-Royce.

Summing up, the key to better lubrication in the dry drawing of steel wire is, in terms of the hydroplane analogy, — more "wing lift", as provided by 'pressure' dies or, better still, by the '3-in-1' unit. As for lubricant development, the most important property to look for is high viscosity at the pressures, temperatures and shear rates found in the die.

Cooling

Earlier on I posed the question why, considering the high interfacial temperatures recorded, the wire does not emerge from the die red hot. Paradoxically, the answer lies in the high drawing speed which restricts the stay of the wire in the die to a few milliseconds or less. Consequently, as shown in Figs. 8 and 9, these high temperatures go only skin deep and, after wire and die part company, the skin is chilled by the core so quickly that by the time the wire emerges into the open, it is not more than, say, 220°F (high-carbon steel) or 120°F (mild steel) hotter than when it entered the die. Moreover, this overall rise of temperature per hole changes little or not at all with speed, so long as good lubrication is maintained. If, nevertheless, faster drawing leads to excessive wire temperatures, it is because not all the heat put into the wire is removed before it enters succeeding dies.

Die Cooling

Before considering any cooling of the wire between holes, it seems logical to remove as much heat as possible at the source, that is in the die. Unfortunately, the scope for this is extremely limited, owing to the high drawing speed and the blanketing effect of the skin friction (see Fig. 8b) which together stop most of the heat of the wire from flowing into the die and only the working surface of the die gets really hot (see Fig. 9). Typical experimental figures for the amount of heat extracted when drawing 0.080 in. mild steel wire through dies cooled with cold tap water are :- 7% of the heat generated at 200 ft./min.; 3% at 1,000 ft./min.; less than 1% at 5,000 ft./min. Even with a water

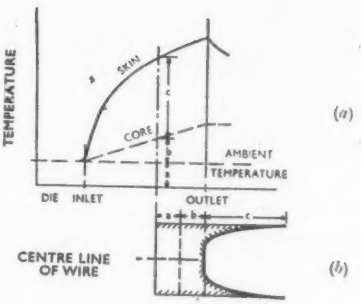


FIG. 8.
TEMPERATURE DISTRIBUTION IN THE WIRE.

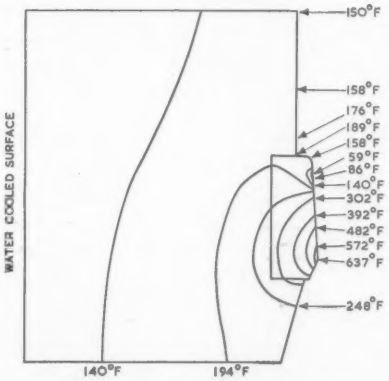


FIG. 9. TEMPERATURE DISTRIBUTION IN DIE AT 1400 F.P.M.

flow rate 10 times the normal, and a turned-down, nickel-plated die case, the improvement is negligible. We conclude that, as far as the wire is concerned, one might as well spare oneself the trouble of cooling the die. It does, however, seem worthwhile to cool 'pressure dies' and the bell of the BISRA unit, to prevent the incoming soap powder from getting overheated prematurely.

Block Cooling

We see that there is no option but to extract as much heat from the wire as possible between holes or, in effect, on the blocks. As for the best method of doing this, opinions are many but hard facts are few. BISRA's most recent work has been aimed at getting hold of these and at spotting the method with the best development potential.

* * *

From measurements in several English wire mills, we conclude that many of the present-day cooling systems are badly designed and, in the case of internal water cooling, the cooling efficiency drops rapidly by 20-40%, through rusting and hard deposits. Internal water spray systems are particularly inefficient, especially at high block speeds, because only a small fraction of the potential cooling surface of the block is wetted by the water. The cooling of blocks fitted with rotating internal water reservoirs is effective at intermediate speeds, so long as the water is well stirred (e.g. by means of stationary water supply pipes feeding to the bottom of the reservoir). At high speeds, however, the cooling performance of this system falls off, on account of the excessive wake formed behind the supply pipes.

* * *

In machines with dual cooling systems investigated by us, the overall contribution of the external air blast to the cooling power amounted to between 20 and 50% of the total. The air blast was generally less effective on the faster blocks, presumably as the result of interference by the vortex generated by rotation of the block. Air cooling was almost ineffective on double-deckers. In general, the cooling performance of the machines examined improved somewhat with speed of rotation. It did not appear to vary systematically with wire size, but it clearly increased with wire tension. The overall cooling capacity of the blocks examined ranged between 30 and 120 B.T.U./sq.ft. hour °F.

* * *

Having got performance figures of existing machines, we turned to the problem of how to improve on them. It struck us that, so far, the machine makers' answer to the problem appears to have been — more water, more air blast, either singly or combined; and when this proved insufficient, — larger blocks. As a consequence, air fan power has, of late, come to represent a substantial (15-20%) proportion of the machine horsepower and the large water consumption has added its share of problems; larger blocks, of course, add disproportionately to the initial cost of the machine. Quite apart

(*Please turn to page* 1550)

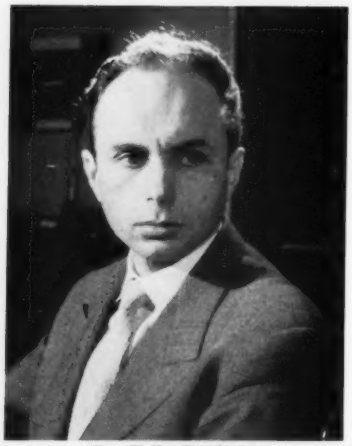
Applications of Photoelastic Coatings to Measurements in Wire Manufacture

by

Dr. Felix Zandman and Frank G. Tatnall

Tatnall Measuring Systems Company

Phoenixville, Pennsylvania



Dr. Felix Zandman

Dr. Zandman was born in Poland and educated in France, where he received a degree in Mechanical Engineering, a Masters degree and a Doctorate. He has worked as Assistant Research Director for the Centre National de le Recherche Scientific, as Chief Research Engineer for SNECMA (mfr. of jet engines), as Technical Director of Photostress France and of PhotoStress, Inc. (U.S.A.) and as Professor of Stress Analysis at the Aeronautical Academy of Engineering in Paris. He began research work on photostress in 1952 and made the first industrial applications in 1954. He is presently Director of Basic Research of the company.

A paper presented at the Annual Convention of The Wire Association on October 13, 1959, in Cleveland, Ohio.

Frank G. Tatnall

Mr. Tatnall graduated from the University of Pennsylvania in 1920 with a B.S. in Mechanical Engineering and in 1925 received a graduate degree. From 1921 to 1924 he was Development Engineer for the Foamite-Childs Corp.; from 1924 to 1926 he was Assistant to President of the Riehle Testing Machine Co. In 1926 he was a co-founder of the Emory-Tatnall Co., manufacturers of hydraulic testing machines. When this company was bought by the Baldwin-Southwark Co. in 1928 he continued his work for the new owners in further developing testing machines. He was made Manager of the Testing Machine Department in 1930 and Manager of Testing Research in 1943 for the Baldwin-Lima-Hamilton Corp. In 1956 he became Vice President and General Manager of Tatnall Measuring Systems Co., a subsidiary of The Budd Co.

Strains can be accurately measured by the photoelastic coating technique (PhotoStress) in many industrial applications, a few examples of which will be shown in this paper. Briefly, this technique consists of coating the part where strain is to be measured, either by brushing on a special liquid plastic or by cementing to the part small photoelastic patches, sheets or strips commercially available. When examined in the field of polarized light, obtained with certain simple optical instruments, black and colored fringe patterns are seen in the plastic when the part upon which it is mounted is strained in tension, torsion, flexure, compression or any combined stress. The PhotoStress then changes strain into color and acts in the manner of an infinite number of bonded strain gages of essentially zero gage length, providing strain readings in terms of magnitudes as well as directions of principal strains. At the same time it affords direct observation, which can be photographically recorded, of the complete strain distribution pattern. In addition to static strains, it will read dynamic service strains, alternating loads and impacts. It can be interpreted in two ways:—

(a) As the difference of principal strain (hence maximum shear);

(b) As the value of each individual principal strain and its direction.

Another approach is the frozen fringe type photoelastic bonded strain gage, which measures strain by the direct reading of the movement of a black fringe line across a scale. Strain is converted to stress in conventional manner.

* * *

The range of measurement is very wide, from 10 microinches per inch (0.00001″/″) strain up to elongations of 3% or 50%, depending upon the plastic used.

* * *

Measurements are made on areas ranging from crystalline grains to large surfaces of structures, as well as in regions of steepest strain gradient.

* * *

PhotoStress can be used for measurements of residual strains, localized plastic deformation, creep and relaxation up to 300°F. It will function when immersed in transparent liquids (water and oil), as well as in any type of atmosphere.

* * *

Regarding limitations, PhotoStress must have light; a known correction must be made for temperatures below −44°F. and above +95°F.; for long time tests temperatures must not exceed 300°F., but for tests up to 30 minutes duration it is useable up to 500°F. The sensitivity of measurement is proportional to the thickness of the plastic coating, so for accurate quantitative measurements, thickness should be known — which is the reason for supplying the patches, sheets and strips in calibrated thicknesses. For qualitative measurements, thickness is only a factor insofar as sensitivity is concerned.

* * *

A spectacular variety of tests, not only in the laboratory but in service in the field and in industrial plants, has been made over a

period of about four years. Tests of structures and components, rather than wire and cable, have occupied the attention of engineers. However, in the case of wire, a spring made of 0.06″ wire under cyclic loading was tested in a typing machine. The wire spring was dipped in liquid plastic and polymerized with infrared lamps. The spring was first tested statically, observing the color pattern in a polariscope fitted with a compensator, to an accuracy of 0.00004″/″. Areas of stress concentration and peak stresses were measured. The spring was then loaded dynamically under service conditions and the strain pattern alternations observed under stroboscopic polarized light.

* * *

The yield point of certain wires and the areas of first yielding in a tension test were observed by the same photoelastic technique. This worked so well that tests were continued to study the propagation of plastic deformation under tensile loading. A coating thickness of only 0.01″ was used for this latter test, so that large plastic deformations could be tolerated.

* * *

During the tensile test of the wire in the elastic range, the coating showed a uniform color, indicating a uniform strain over the gage length. First incipient yielding was detected by the sudden appearance of sharp color gradients in a very narrow area, pointing to sharp strain variations which could only be attributed to local plastic deformation. When the test piece was unloaded, a permanent fringe pattern indicated an extremely localized permanent set. Subsequent measurement of wire diameter at this region revealed a reduced area.

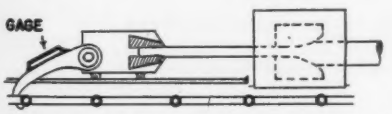
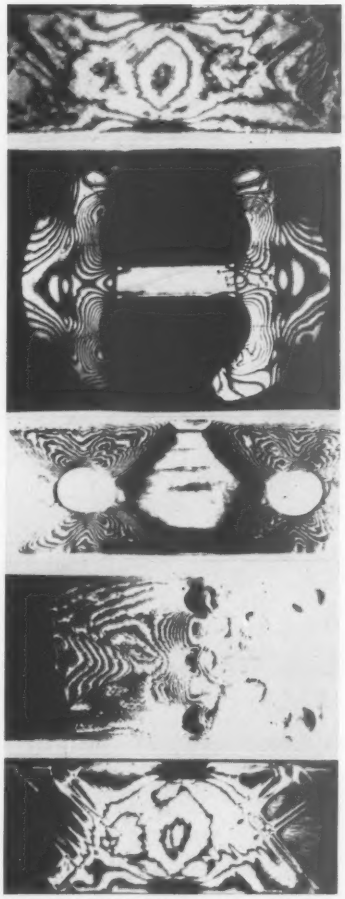


Figure 1 * * * * * * * * * * *

The propagation of plastic deformations was recorded with a high speed motion picture camera, shooting through the analyzer of the polariscope used in the test. Other phenomena that also showed



Photographs illustrative of the behavior of photostress under strain. * * * * * *

up in the patterns in this test were grain fragmentation and slip lines, clearly revealed in measurable color bands.

* * *

From this test was determined the optimum shape for wire when it works as a spring, also the exact first localized yield point of the wire in such configuration, not the average yield value. The difference of the yield point determined first by a 1″ gage length mechanical extensometer and then by the photoelastic coating technique reading local deformation was 30%, although the photoelastic coating for average yield point over 1″ gage length agreed with the mechanical extensometer. Photoelastic coating on the entire length of the wire continually looks at each local area along its length.

* * *

Typical fringe patterns are shown in Figures 1 and 2 in the color slides (black and white in the paper).

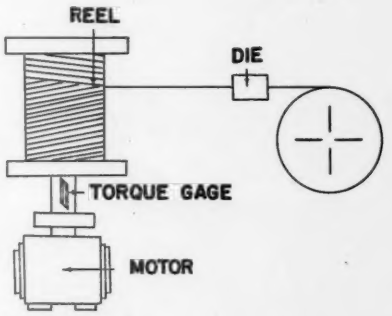


Figure 2 * * * * * * * * * * *

There are many other industrial measuring possibilities with PhotoStress in wire manufacture — for instance:

1. Wire Drawing

To measure the drawing load on the grip head, the hook on the head which engages the chain can have a PhotoStress frozen fringe strain gage mounted upon it (Fig. 1) and the unit calibrated in a testing machine as a tension dynamometer. The frozen fringe gage performs the combined function of strain gage bridge, power supply amplifier and load indicator, read directly by eye. If the wire is being drawn onto a reel, the torque can be read by mounting a frozen fringe gage on the driving shaft of the reel (Fig. 2).

2. Wire Testing

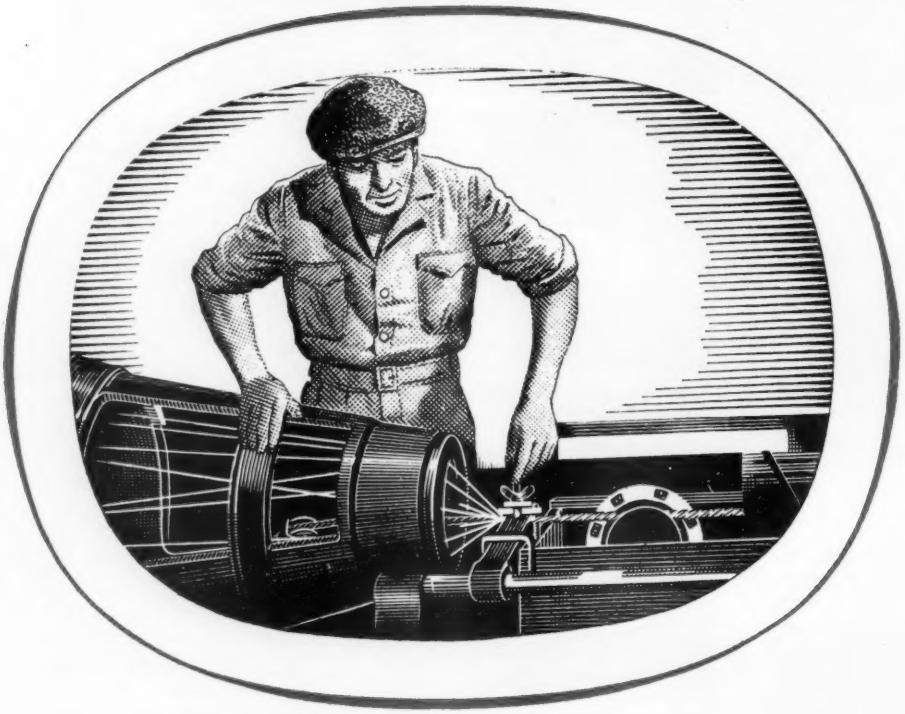
Plastic can be applied to wires of small diameter by the brushing on of liquid, similar to the preparation of cables with rubber or polyethylene insulation. A wire thus treated can be said to have a photoelastic extensometer mounted upon it to observe local plastic deformation or average yield point. The plastic coating can monitor the behavior of the whole length of wire sample up to fracture.

Figure 3 * * * * * * * * * * *

3. Cable Testing

PhotoStress can serve as a cable extensometer by the bonding of small PhotoStress shells (two half shells) to the cable (Fig. 3), in

(*Please turn to page* 1552)



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L.B.I.

High Speed Rod Rolling— No. 1 Rod Mill, Cuyahoga Works

by Earle L. Chamberlain
Division Superintendent
Hot Mills — Cuyahoga Works
American Steel & Wire Division
United States Steel Corporation
Cleveland, Ohio

Many of you have no doubt heard or read something about our new No. 1 Rod Mill (see Fig. 0). In fact Mr. W. V. Magee, our Assistant Chief Engineer, gave a paper entitled "American Steel & Wire's New Rod Mill", which was published in the September, 1957, issue of the AISE magazine. We installed this high-speed mill at our Cuyahoga Works in 1956, and recently set a new 24 hour record of 2105 tons and a weekly record of 11,399 tons. I would like briefly to describe the operation, equipment and material flow, discuss some of the problems we encountered and tell you how we endeavored to overcome them.

* * *

This is a schematic drawing of the layout of the mill. We built this mill 14 feet above ground level so as to be able to accommodate oil storage, reel pits, scrap disposal, locker rooms and other auxiliary equipment on ground level rather than in basements.

* * *

Steel is received in 10-15 tons chain lifts via gondola cars and trucks, and is stored in two adjacent billet yards (Fig. 1). The billets pictured are 3¼" x 3¼" x 30' long and weigh approximately 1050 pounds. Eventually, all billets will be 34' long and weigh 1200 pounds. Combined storage capacity of the two yards is about 58,000 tons.

Earle L. Chamberlain

This paper was presented at the Annual Convention of The Wire Association on October 14, 1959, in Cleveland, Ohio. **The author joined the company as a trainee in the Cuyahoga Works in 1934, working as a Scrap Baller on the No. 2 Rod Mill. In July, 1944, after working at various assignments, he became Turn Foreman on this Rod Mill. He was made Temporary Department Superintendent, Rolling Mills in 1947, Department Superintendent in 1948 and Division Superintendent, Hot Mill Division, in 1952, his present position.**

* * *

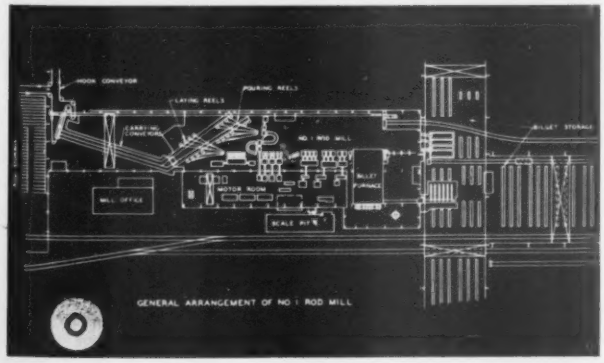
Billets scheduled for the mill are placed on the Billet Unscrambler (Fig. 2) directly from storage or gondola cars. The unscrambler has two sets of oscillating skids located between stationary skids, which separate and align the billets before they enter the furnace feed table trough. From there they are pushed into the furnaces by a charging car. Incidentally any combination of billets from one through four may be charged to the furnace at one time. An automatic billet counter records and totals the number of billets entering the furnace.

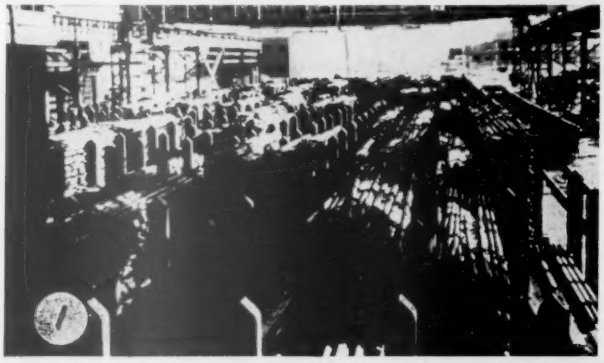
* * *

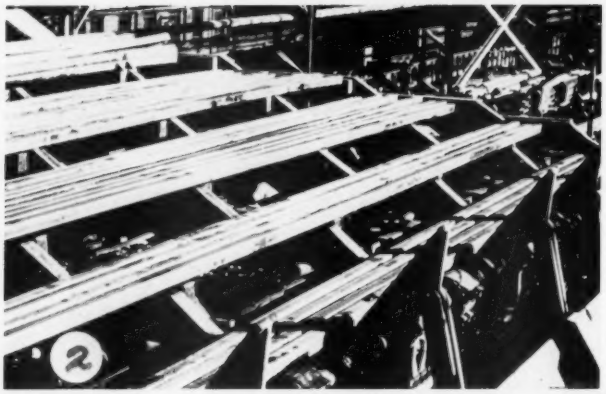
The furnace will hold 250 billets and is of the two zone, side charge and discharge type, with a capacity of 100 tons per hour. It has an effective hearth area 38 feet wide and 70 feet long. Generally, natural gas and/or coke oven gas is used as the fuel for heating, but oil has also been used successfully. The fuel consumption is approximately 250,000 cu. ft./hr. at capacity (1500 M BTU/Ton of steel).

* * *

Billets are charged to the mill through the use of an electrically operated "peel or pusher bar" (Fig. 3) operating on oil-hydraulic cylinders. This entire unit travels the width of the furnace discharge door, in order to line-up the bar with any of the possible billet positions in the furnace.







Reversible pull-out rolls, (Fig. 4) located on the mill side of the furnace, aid the charging of billets to the mill. These rolls may also return a portion of a billet to the furnace in the event of a cobble in the Roughing Mill.

four-stand intermediate roughing mill, a six-stand intermediate finishing mill, and an eight-stand finishing mill for continuous rolling — or a two-stand finishing mill for semi-continuous rolling. A total of 13,500 horsepower is used to drive the mill.

* * *

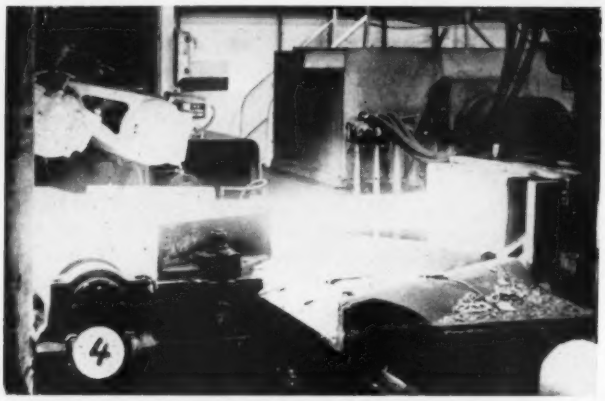
The finest and coarsest size rods are produced by continuous rolling, and intermediate sizes are produced on the semi-continuous mill. The size ranges produced continuously are #5 Rod through 27/64" and 1-5/32" through 1-1/2". Intermediate sizes from 7/16" through 1-1/8" are produced on the semi-continuous mill.

* * *

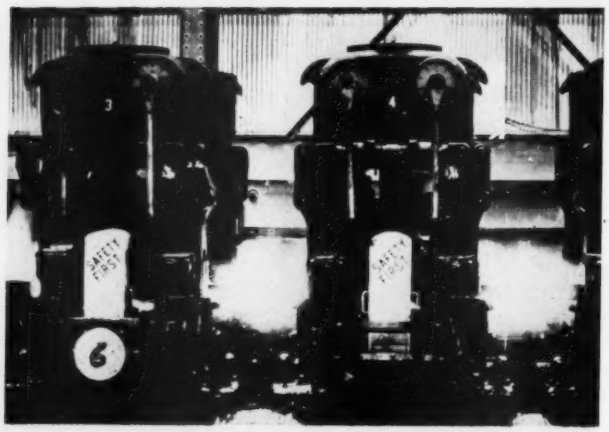
The looping mill is equipped with rotary disk dividing shears which are designed to cut and switch the rod in one motion. Therefore, we are able to supply our customers with either 500 or 1000 lb. bundles.

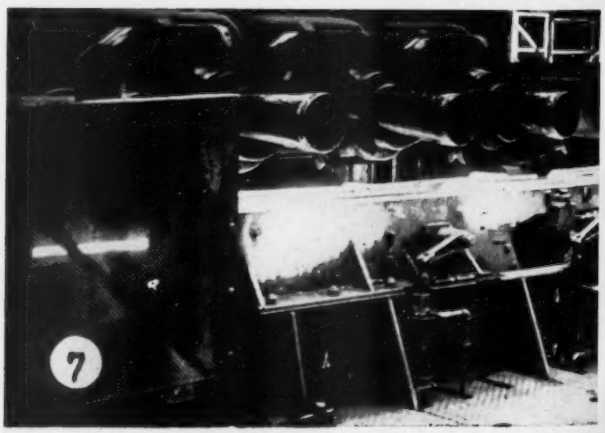
* * *

The roll housings are all of closed top construction and are equipped with oil film bearings and parallelogram devices for axial adjustment of the bottom rolls (see Fig. 6). All mill screwdowns are operated by



The four strand mill (Fig. 5) consists of a maximum 23 stands for continuous rolling operations or 17 stands maximum for semi-continuous or looping operations. A speed of 6400 feet per minute is possible, when rolling continuously. The main "breakdown" sections of the mill consist of a five-stand first roughing mill, a





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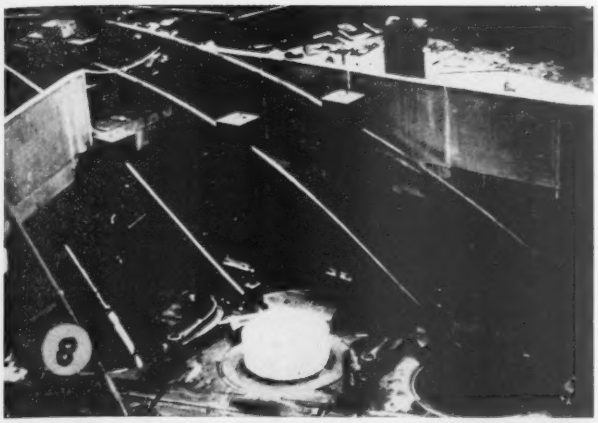
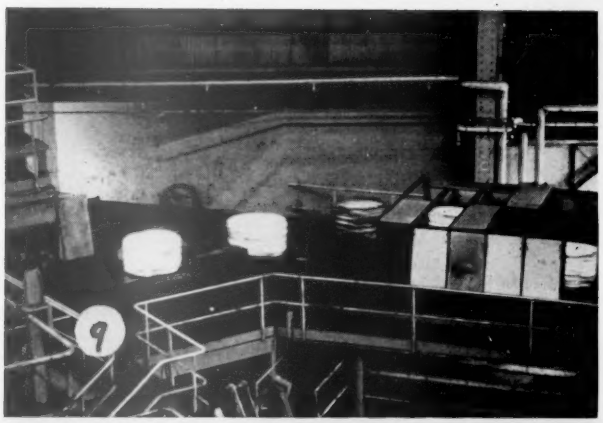
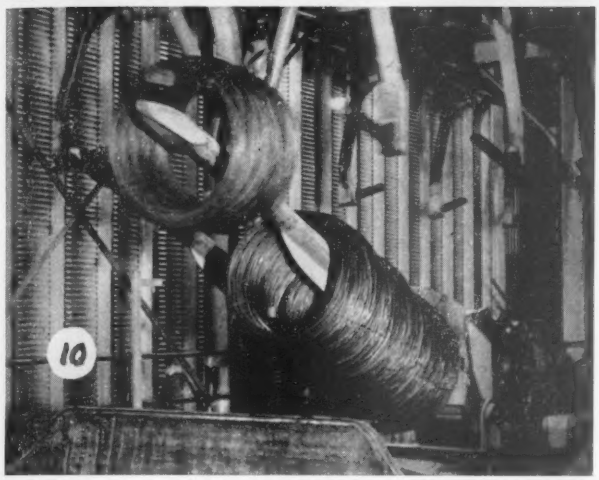
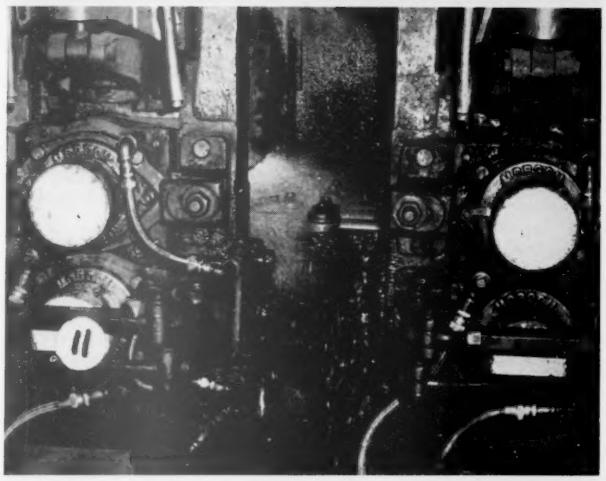








hand ratchet wrenches as shown, with the exception of No. 1 stand, where a motor drive is employed on each screw. To facilitate roll changes, each mill position has two complete roll housings so that the rolls can be set up in advance for the next size change because of worn passes.

* * *

A crop and cobble shear (Fig. 7) for each line is located between the second roughing and the intermediate finishing stands. These shears go from stop position to rod speed and back to stop in one cycle. Their function is to crop the front ends of the process bars, and cut the process bar into short lengths in the event of a cobble.

* * *

Eight enclosed laying reels are utilized in coiling #5 rod through 27/64″ rod, and eight pouring reels (Fig. 8) for coiling course rod, running from 7/16″ through 1-1/8″. Two special reels are used for rod measuring 1-5/32″ through 1-1/2″.

* * *

Two drag conveyors (Fig. 9) serve both the laying and pouring reels. These conveyors in turn deliver the coils to the Hook Conveyor, which is approximately one mile in length. The lengthy Hook Conveyor is necessary to allow the rods to cool before reaching the Inspection Department. All inspection, trimming and banding of coils is done while the coils are travelling on the Hook Conveyor. This is no simple matter when one stops to consider that as many as two hundred coils may be processed in one hour. Our inspection consists of upset, etch, nick and break and magnaglow testing. The coils are then removed from the Hook Conveyor at any one of five Unloaders (Fig. 10).

* * *

The rod bundle unloaders are designed with two rams and a transfer conveyor. While one ram is indexed in line with the Hook Conveyor and strips rod bundles from the hooks, the other ram is lowered into position and deposits its lift of bundles on the transfer conveyor. An overhead crane carries the lift away from the transfer conveyor with a "C" hook for direct shipment to the trade or for storage for our Wire Mill.

* * *

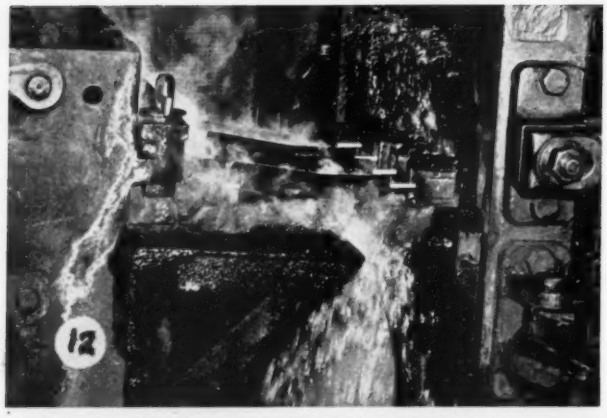
That, very briefly, is a description of the mill and how it operates. Now, let me mention a few major problem areas that were encountered.

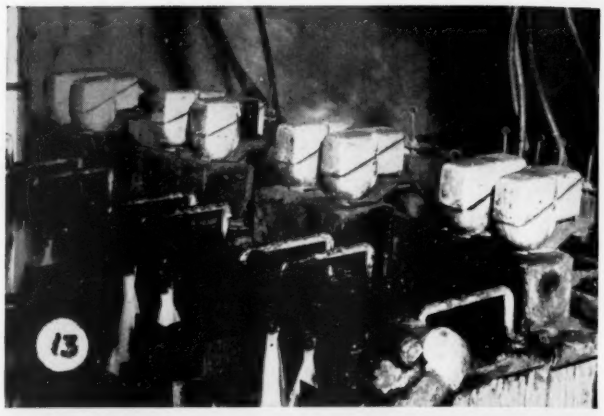
* * *

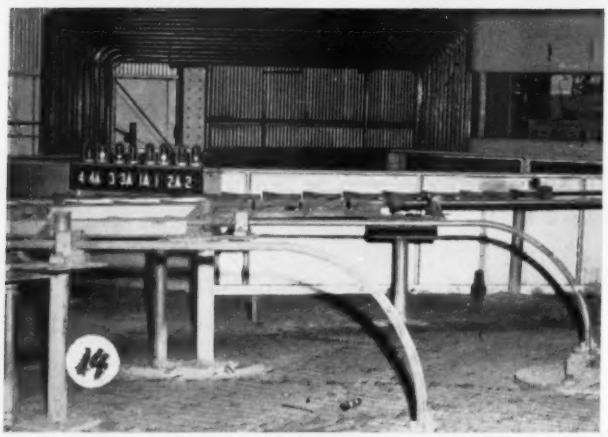
The eight-stand finishing mill in general, including guide design and material, making 5 rod at 6000 FPM and coiling low carbon 5 rod, were our biggest hurdles.

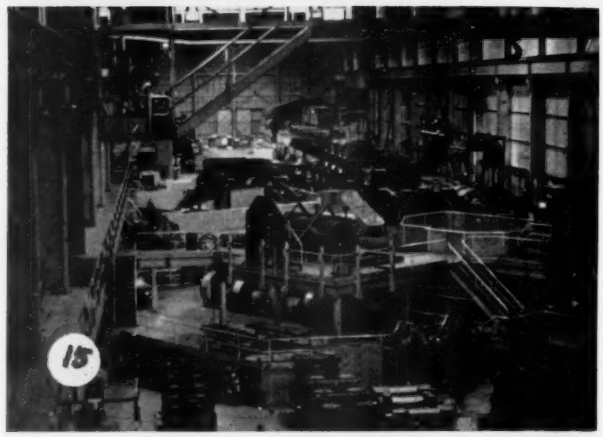
* * *

The grinding, setting and analysis of our friction guides proved to be more critical than we experienced on our old slower speed rod mills. Because of the additional friction heat, guides would "pick-up" more readily, and cause a cobble. This pick-up was common to both oval receiving and twister guides. We experimented with many different guide designs, methods of grinding and guide ma-









terial before we found a solution.

* * *

Bronze receiving and twister guides in the finishing mill have proved to be our best material. Grinding the oval receivers with as short a bearing area as possible keeps pick-up down to a minimum. Increasing the degree of twist and improving the design of the nose of the twister guides also helps to reduce cobbles.

* * *

Running at these high speeds, the guides have to be set perfectly on the hole. A guide even slightly off the pass will give trouble further along in the mill.

* * *

We found that the installation of roller twister guides, (Fig. 11) in conjunction with our bronze twisters and bronze receiving guides, increased friction guide life, reduces mill cobbles and generally stepped up our rolling efficiency. I might add that from a quality and yield point of view, because of the high rate of production, keeping the mill in top rolling condition at all times became even more important. The operating crews became pseudo engineers, improving methods and procedures to stay ahead of the 6000 FPM mill. They learned to adjust the roller twister guides to maintain proper twist when four bars were in the mill and to keep all the mill sections uniform, in spite of the long reach to the inside strand.

* * *

Maintaining a fixed metal line throughout the entire mill also was found to be very important. This is normally checked when rolls are set up for installation in the mill. To insure maximum accuracy, a surface gauge was designed to set the roll at precisely the proper height.

* * *

The snap shears (Fig. 12) ahead of #16 stand were originally designed to be operated manually by the motorman or one of the finishing mill crew. With four lines going through the mill, it was very difficult to tell which one of the lines was cobbling. Since the stands are closely coupled, a cobble in one line often would knock out the other three lines. Consequently, removing a cobble became a serious problem. In some instances, the mill would have to be shut down and the overhead crane used to remove the cobble. To correct this, four photo electric cells and a timer have been installed behind #15 stand (Fig. 13). If the bars being rolled do not reach the switching cell within a given time, the shears will automatically cut, thus reducing the amount of scrap between the stands.

* * *

The laying reel pipes originally were ¾" I.D. water-jacketed pipes, which extend out about six feet from our last finishing stand and thence into vertical air-operated switches. Beyond this point, we went into 1¼" I.D. high pressure descalers and water eliminators before going into more 1¼" I. D. water-jacketed pipes. The radius of the curved pipes entering the laying reels was about 6½ feet, which was about 55" above the metal line of the finishing mill.

* * *

We found that on 5 rod high carbon, and on all grades of steel for sizes greater than 5 rod, little

or no difficulty was encountered delivering into the laying reels. But, while rolling low carbon 5 rod, we had mysterious cobbles which could not be accounted for. We reduced our cobble frequency somewhat by installing ½" I.D. pipes on the delivery side of #23 stand. However, our performance still was not satisfactory, so we replaced the vertical switches with horizontal switching, (Fig. 13) having simplified mechanical design for more positive switching action. As shown in the picture (Fig. 13), water eliminators were added to prevent the rod cooling water from passing under the electric eye. The reel pipes were lowered so that the curved pipes leading into the reels had a radius of approximately 32", which is about 1" above the metal line of the mill. Finally, the ¾" I.D. water-jacketed pipes were replaced by short ¾" cast iron pipes (Fig. 14) from our switches to the curved pipes. This combination has provided the best results to date. Eventually, we hope to install short curved cast pipes delivering into the reels.

* * *

The high finishing speeds of No. 1 Rod Mill opened a new door for roll material analysis. A tough, and possibly harder, composition is needed to withstand the high temperatures and rolling speeds.

* * *

It was natural that the introduction of a mill of such speed and capacity would pose problems of orientation and adjustment for our crews (Fig. 15). Many of the men had worked on a single strand mill — 2200 FPM maximum delivery speed; some had experience on a three-strand mill with speeds of 3200 FPM maximum. However, the 6000 FPM speed presented a challenge, which I am happy to say has been successfully met. So well have our crews adjusted to the mill, that they are now able to pull cobbles and set guides while other strands still are rolling. The need of adjustment did not end with the operating crews. The technical background of our Maintenance crews had to be developed further to keep pace with the modern mill design. Our Engineering Department developed and utilized automatic controls insofar as practicable to reduce material handling and increase production efficiency. The level of performance of the responsibilities associated with No. 1 Rod Mill had to be streamlined to meet the mill's production potential. The mechanization of the Accounting and Production Planning system is presently being installed to furnish operating statistics and schedules necessary for more efficient operations. New problems relating to temperatures, structures of steel and testing procedures needed to meet customer demands had to be solved by our Metallurgical Department.

The combination of four strands at 6000 FPM represented a breakthrough of technical ceilings, and the patience and understanding of supervisory and executive responsibilities proved to be an important asset during the early period of mill operations.

* * *

As a result, our production has been on a positive slope. In February, 1959, we achieved what no other mill in the world has ever done; an average 515 tons per turn for 75 consecutive turns. Furthermore as I said earlier, a new 24 hour record of 2105 tons, and a weekly record of 11399 tons have since been established.

* * *

Even in the face of this performance, we are confident that we have not yet reached the optimum efficiency of No. 1 Rod Mill, and that has been proven by our March tonnage of 551 tons per turn for 83 consecutive turns; and a total of 45,734 tons for the month.

* * *

In conclusion, for those interested in individual 8 hour records by sizes, they are as follows:

Size	*Total Tons*
5 Rd.	648
5/16"	670
11/32"	732
3/8"	691
27/64"	790
17/32"	780

A Special Invitation to Our Readers

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Copper's Future

by Robert P. Koenig
President
Cerro de Pasco Corporation
New York, New York

Mr. Koenig prepared this address for presentation before the Non-Ferrous Division of The Wire Association on October 14, 1959, during the Association's Annual Convention in Cleveland, Ohio.

Earlier this year, in an address prepared for presentation before the National Association of Waste Material Dealers, I discussed the prospects for copper consumption and production over the years to 1965.

* * *

On the demand side, I foresaw over-all copper consumption for the Free World in the year 1965 attaining a level of 5.1 million short tons, as compared with 3½ million tons in 1958.

* * *

As for production, I indicated the likelihood of an increase in Free World copper mine capacity to something approaching 4¾ million short tons in 1965, as compared with 3.2 million tons in 1958.

* * *

I said at the time that my confidence in the future course of copper consumption was based on strong growth factors present in an expanding world economy. I suggested that a projection of these factors into the future lent support to expectations of a further rise in the world's copper needs, a rise accompanied by increasing supplies selling at relatively stable prices.

* * *

Nothing has happened in the intervening months to alter my confidence in copper's future. The outlook for the industry is bright. Within the next few minutes, I propose to share with you the articles of my faith in copper's future.

* * *

An illustrious American patriot, Patrick Henry, coined a phrase applicable to the present circumstances when he declared, "I know of no way of judging the future but by the past."

* * *

Copper's past, as even the most jaundiced observer will agree, has been impressive. For the past 8,000 to 10,000 years the metal has been used in the service of mankind, and its consumption over the years, particularly in the interim dating from the Industrial Revolution, reflects a steady upward trend.

* * *

This trend, furthermore, continues upward despite the competition posed by aluminum, stainless steel, plastics and other corrosion resistant materials. These competitive materials will continue to impinge on the market for copper, but it is important to bear in mind that the penumbra zone where the competition occurs is limited and that, by contrast, the area wherein the unique characteristics of copper predominate and stand alone will continue to loom very large indeed.

* * *

I should like to suggest that there is need at present for realism and confidence in the face of a rising flood of propaganda to the effect that copper, like the dodo bird, is a relic of bygone days. Copper, to be sure, is on the run, but I submit that the course, as plotted on the usage charts, is one of constant ascent to higher ground. If this be retrogression, let us have more of it.

* * *

The simple truth of the matter is that, after thousands of years, the copper industry is still expanding.

* * *

The reasons may be found in three developments of major significance for copper's future:

First, the explosive rate of world population growth;
second, economic expansion and industrialization on an unprecedented worldwide scale; and
third, the accelerated growth in prospect for the major copper-consuming industries.

World population, according to the United Nations demographic yearbook for 1958, is growing at a **net** rate of about 85 persons a minute, 5,000 an hour, 120,000 daily, or some 45 million human beings per year. This is the equivalent of adding the inhabitants of a country the size of France to the world population annually.

* * *

World population grew slowly and spasmodically, held in check by epidemics, famines, droughts wars and other disasters, until it reached 500 million in the year 1650. In the next three centuries it more than quintupled to a total currently in excess of 2.8 billion, and shows no signs of slowing down. By the year 2000, only 40 years from now, world population, as projected by the U.N., will reach 6¼ billion.

* * *

The annual birth rate is running far ahead of the death rate, and the rate of gain is being applied to an ever-larger numerical base. Furthermore, the death rate could decline even faster if scientists score new break-throughs against heart disease, cancer and other killers.

* * *

In any event, demographic experts foresee a new wave of births starting in the late 1960's as the postwar baby crop reaches the age of parenthood. This wave may lead to still another, bigger expansion as the century closes, when the second postwar generation in turn begins marrying and having children.

* * *

Now what does this foreshadow in terms of prospective world demand for a raw material such as copper? World population, taken alone, is not in itself translatable into economic growth, except as

related to the simple needs for food, clothing and shelter. Given a vast technological revolution in combination with a burgeoning world population, plus dramatic new political and social changes in effect over much of the world, and you have a dynamic situation indeed.

* * *

In these circumstances, more people will mean more markets for business and industry, a growing demand for more goods, all the things that signal the presence of a thriving world economy. Industry will find it necessary to dig deeper into world reserves of fuel and minerals. Modern technology will be hard pressed to keep pace with everyday needs. As a result, population analysts foresee a search for new sources of power to replace the fossil fuels—oil and coal, new farming methods to boost yields per acre, new ways of obtaining the water vital to existence, and new techniques for recovering food and raw materials from the ocean depths.

* * *

Given these conditions, the demand for copper will continue to expand, and the rate of expansion may well stimulate a search for new ore on a scale unprecedented in copper's long history. The prospective demand is illustrated by reference to the ratio of United States' versus the outside world's copper consumption. William P. Shea, writing in a recent edition of Engineering and Mining Journal, points up the fact that the United States, comprising 7% of the world's population, is absorbing over 35% of the world's entire production of copper. There is thus an indicated assurance of a continuing expansion of world copper consumption as the other 93% of the world's population raises its standards of living and becomes more "copper-minded" than heretofore.

* * *

There can be no question of Soviet Russia's emergence as a formidably industrialized nation. In the economic sphere, the Communists have hit the headlines with Mr. Khrushchev's fixing on 1965 as the year by which to fulfill the Soviet production targets first planned for 1972—targets which would send Russian production surging ahead of Western Europe's and bring it within sight of America's present strength. Our major competitor happily is still behind us, but, if you clock his speed, you will find that he's going fast. In fact, he's going much faster than we are.

* * *

Even more remarkable in its way is the Chinese claim to have doubled food production by total mobilization of the Chinese countryside. China has announced long-term plans for industrial expansion patterned along the lines of Russia's five-year plans. The manner in which she has mobilized her strength in boosting agriculture output suggests that her progress in the industrial sphere will be no less dramatic. India and Indonesia both have ambitious industrial development programs under way. Among Latin American countries, Mexico, Brazil and Argentina are fostering both power development and industrialization.

* * *

The industrialization of the so-called underdeveloped areas of the world will quicken the demand for copper. And however modest the initial requirements or slow the beginning rates of growth, their application to such a large proportion of the world's population indicates a steady progression in over-all demand which the world's copper producers will be called upon to meet.

* * *

In this connection it is interesting to speculate what the world demand for copper will be when the rest of the world raises its per capita requirements above present levels. As matters now stand, the per capita consumption per annum of virgin copper by the United States amounts to approximately 15 pounds. The corresponding figure for the rest of the world is in the neighborhood of 2¾ pounds. Assuming that the same copper consumption ratios remain fixed over the next five years, and using population projections based upon the most recent United Nations' studies, world copper consumption in the year 1965 would total about 4.2 million short tons.

* * *

Now, let us assume momentarily that the per capita requirements for the remainder of the world were to undergo an increase over the next five years to a level one-third that of the current United States figure, thereby making the ratio 14.7 pounds U. S. versus 4.9 pounds elsewhere. In that event, assuming the projected population growth mentioned a moment ago, total world copper consumption by the year 1965 would attain a level of 6.4 million tons, as compared with my earlier projection of 5.1 million short tons.

* * *

It is in order to observe at this point that there is always a danger of overinflating the extent of future trends if one relies too heavily on hypotheses based upon guesstimates, for example, of anticipated growth in per capita consumption. The essential point which bears repeating, however, is that of the definite correlation which exists between expanding industrialization and the need created thereby for increased copper supplies.

* * *

Having now considered the burgeoning growth on a world scale of the twin factors of population and industrialization, we come next to the increased requirements implicit in the expansion of the major copper-consuming industries.

* * *

Most of the present industries using copper continue to show strong growth characteristics and several powerful consumers of the metal, of which atomic energy is one example, have been recently added to the list.

* * *

Taking copper in all its forms, almost half the world's consumption goes into various electrical uses, including power transmission, electronics, communications, electrical equipment, transportation and complex weapons systems. Motor vehicles absorb about a tenth of the world's copper supplies, and building construction another tenth of the total. Shipbuilding and related engineering industries take approximately a fifth, and this area of usage combined with the industries just mentioned — electrical, motor vehicles and construction— account for perhaps nine-tenths of world consumption. In addition, of

course, significant quantities are absorbed in aircraft, rockets and missiles, railroad equipment, appliances, machinery and equipment, coins, water distillation, scientific instruments, utensils and jewelry, to mention a miscellaneous but important grouping.

* * *

Obviously, the future rate of increase in copper consumption will depend, first, on the future prospects for each of these consuming industries, and second, on the changes that may occur in respect of the usage within these industries of copper and its alloys.

* * *

Broadly speaking, the progress made by the electrical industries is geared to the rate at which electrical demand grows. Throughout the first half of the Twentieth Century, electricity consumption in the United States and Great Britain doubled every decade and, taking the world as a whole, there seems little reason to doubt that this rate will be maintained, if not greatly exceeded.

* * *

A recent industry survey, for example, forecast a rate of increase in the United States of considerably more than 110% during each of the two decades from 1955 to 1975. Other informed sources report, with regard to the future consumption of electrical energy abroad, that the rate of growth for the Free World outside the United States should be little, if any, less than the growth anticipated here.

* * *

The transmission of power continues to be a major market for copper, even though aluminum has succeeded in taking over in the field of overhead high voltage lines. Power generation, however, continues as a significant copper-consumer for heat exchangers and in windings for motors, generators and transformers. In high voltage undergroud lines, copper is a prime necessity and this usage should expand in proportion to the rate of population growth.

* * *

Telephone and telegraph wire and cable represent major markets for copper, and with the upward surge of world population, an increase in demand appears inevitable. Here in the United States, at the close of last year, more than 66 million telephones were in use, a figure which industry spokesmen predict will be boosted to 76 million by the year 1965. The central office equipment required to service this expansion, together with the coaxial cables and myriad components in radio equipment and telegraph sending and receiving equipment, all add to the size of the major market represented by the communications industry.

* * *

Other factors supporting the long-term growth in the electrical uses of copper are increased electrification of industry, as in the case of electric furnaces and rolling mills, and the general trend toward automation. Printed circuits, for example, represent a growing market for copper, as does the field of computers. Univac, to cite one instance, uses approximately 8 tons of copper and copper alloys, or roughly 40% of its total weight of 20½ tons.

* * *

The shipping industry, to turn next to another major consumer, faces an expansive future. If world trade continues to grow at, or improve upon, the recent rates of 5% to 6% per annum, based upon world exports, then more ships will be needed. And older vessels will of course need replacing. Under these conditions, there seems little reason to suppose copper will be used to any less extent than in the past. Although some influence on the fittings side may be exerted by plastics and aluminum, the introduction of radar, fire detection systems and mechanical handling gear may very well work the other way and stimulate the use of copper. In addition, the expanded use of underwater craft, and in particular of nuclear submarines, provides a further source of demand. The Navy's latest nuclear underseas craft, for example, requires something on the order of 50,000 feet of copper tubing in hydraulic, air and lubricating oil lines, not to mention miles of copper wire in electrical circuits. If expansion of the shipping and marine industry proceeds at a rate suggested by these developments, the industry may be expected to absorb 1,000,000 tons of copper by the year 1965.

* * *

The recent and projected expansion of the world economy has an important concomitant in automobile production and use. Production of motor vehicles has increased by an average of approximately 4% a year over the past 25 years outside the United States, and the rate of growth within this country has proceeded a good deal faster. In the long run there can be little doubt that world demand for motor vehicles will continue to grow as personal incomes rise and commercial needs expand. A rough projection of the past trend—admittedly without reference to income or population movements, in themselves a statistical exercise—suggests that vehicle output might rise another 30% by 1965. Industry spokesmen in this country predict that new car sales will mount to 8 million annually in 1965, as compared with output this year in the neighborhood of 6 million. Copper has lost a part of its automotive market to aluminum, but motor vehicles will continue to be major consumers. The average 1958 model car used 40 to 50 pounds of copper, and the possibility of increased demand for air conditioning units, which require up to 30 pounds of the metal, suggests that copper may well hold its own in the motor car field, with consumption by 1965 approaching 500,000 short tons.

* * *

In regard to building construction, there are no over-all figures for the world as a whole, although in the United States home building has averaged about 1.3 million units annually. Something of a boom in house building has occurred over the past year, however, as builders in this country, taking advantage of the low interest rates of a year ago, started new houses at a near record pace. There are indications that this level will not be maintained, since the basic demand for new housing, as measured by the number of new family or household units seeking dwellings, is at a low ebb because of the low birth rates of 20 years ago. As the so-called "war babies"

(*Please turn to page* 1546)

Drawing Titanium and Zirconium Wire

by Robert Knight
Sales Manager
Johnston & Funk Metallurgical Corporation
Wooster, Ohio

This paper was presented at the Annual Convention of The Wire Association on October 13, 1959, in Cleveland, Ohio.

Titanium and zirconium, two of the more glamorous metals in industry today, have become firmly established in many specialized applications; but, even so, many people still are quite unfamiliar with these new metals. I believe it is important, therefore, to review, first, the manufacture, characteristics, and applications of titanium and zirconium and to describe briefly the nature of this particular business before discussing the drawing of titanium and zirconium wire.

* * *

Both titanium and zirconium are very abundant in the earth's crust — titanium in the form of rutile (TiO_2) and zirconium in the form of zircon sand.

* * *

Oxides of either metal are first prepared and then reacted with chlorine, the product being titanium or zirconium tetrachloride. Subsequently, the tetrachloride of either metal is reduced with sodium and the pure metal is obtained in the form of a spongy mass, plus sodium chloride (salt). Leaching with water follows to wash the excess salt from the sponge.

* * *

Molten titanium and zirconium are extremely reactive with nitrogen, oxygen, hydrogen, and carbon and will dissolve large quantities of these elements. This interstitial contamination adversely affects the workability and properties of both metals to such an extent that double vacuum melting by the consumable electrode process is required to produce ingots that are pure enough for fabrication and use in industry.

* * *

Titanium and zirconium ingots can be processed on standard mill equipment, but special precautions must be exercised to minimize contamination from the elements previously mentioned. Hydrogen can also be absorbed at room temperature during pickling. Fortunately, hydrogen, which penetrates throughout the base metal, can be reduced to acceptable levels (see Table 1) by vacuum annealing at temperatures from 1200 to 1500° F, and at pressures below 3 microns.

TABLE I

Specification	Grade	Max. Permissible H_2 Content
AMS-4900	JF-55	150 ppm
AMS-4901	JF-70	150 ppm
AMS-4902	JF-40	150 ppm
AMS-4911	JF 6Al-4V	150 ppm
AMS-4925	JF 4Al-4Mn	125 ppm
AMS-4953	JF 5Al-2.5Sn	150 ppm

Oxygen and nitrogen contamination at the surface occurs even during the shortest exposure now possible in mill processing. This contaminated layer is removed from titanium by sandblasting, salt bath descaling and/or pickling in HNO_3 + HF. In the case of zirconium, sand or metal-grit blasting is the most practical method for removing the oxide layer.

* * *

Titanium weighs only 56% as much as steel and the pure metal and alloys possess tensile strengths which result in strength-to-weight ratios exceeding those of nearly all steels. This attractive characteristic makes titanium ideal for numerous applications in the aircraft industry.

* * *

The high temperature characteristics of titanium permit continous service at temperatures up to 800° F and for brief periods up to 2000° F. Titanium exhibits phenominal resistance to corrosion, is immune to salt water, marine atmospheres and to many acids, alkalies and other chemicals, and is rapidly replacing other materials in the food, chemical and marine industries.

* * *

The use of (hafnium-free) zirconium as a structural material in nuclear reactors is growing rapidly because of its combination of properties:

Low neutron absorption,
Suitable mechanical properties,
Satisfactory resistance to radiation damage,
Excellent corrosion resistance.

* * *

Zirconium is resistant to attack from both acids and alkalies and offers excellent performance and longer life where exposures to both types of corrosive media is encountered.

* * *

Most of the titanium and zirconium is produced today by six major concerns. The production of titanium and zirconium wire is currently confined to a small number of shops which are part of or closely associated with the major producers and has not yet been undertaken by small independent manufacturers for a number of reasons.

* * *

The magnitude of this business is small when compared to the steel and copper wire industries. Orders usually consist of pounds rather than tons.

* * *

Applications for titanium wire presently lack diversification and depend, for the most part, on aircraft contracts. This leads to extreme peaks and valleys in demand.

Zirconium wire also lacks diversification of applications at the moment; it depends mostly on the atomic power industry and, consequently, is also a cylical business. Currently, efforts to alleviate this situation are being made through extensive market research which is aimed at developing a more diversified field of application for both metals.

* * *

Typical mechanical properties for annealed titanium and zirconium are shown in Table II. It will be noted that for titanium the yield strength closely approaches the ultimate tensile strength. Because of this close proximity of yield strength to ultimate tensile strength, reductions per pass tend to be quite small in order to avoid breakage during cold drawing. Reductions of 25% are sometimes used; however, 12% reductions are more common. At elevated temperatures, the ultimate-to-yield strength ratio increases markedly. This permits heavier reductions per pass; however, to date the operating problems associated with hot drawing have prevented this type of processing from competing successfully with cold drawing.

TABLE II

Typical Mechanical Properties of Annealed Titanium and Zirconium

Grade	Ultimate Tensile Strength, psi	Yield Strength 0.2% offset, psi	Percent Elongation	Hardness Brinell 3000 KG Load	Hardness Rockwell
JF-40	65,000	55,000	23 in 1"	140	45 Ra
JF-55	80,000	65,000	21 in 1"	190	58 Ra
JF-70	90,000	80,000	20 in 1"	220	64 Ra
JF 4Al-4Mn	150,000	140,000	14 in 1"	320	34 Rc
JF 6Al-4V	140,000	130,000	15 in 1"	310	33 Rc
JF 5Al-2.5Sn	130,000	120,000	15 in 1"	290	31 Rc
Unalloyed Zirconium	60,000-70,000	35,000-45,000	25-30 in 2"		75-85 Rb
Zircaloy II	70,000-80,000	45,000-55,000	20-25 in 2"		85-95 Rb

An additional problem in drawing titanium and zirconium wire is the inherent tendency of these metals to gall or seize in the die. For this reason, it is extremely important that titanium and zirconium be properly prepared in order that a continuous, adherent coating of lubricant is maintained during the drawing operation. This galling or seizing problem is another reason why titanium and zirconium are drawn with light drafts and also at slow speeds of only 30 to 100 feet per minute.

* * *

At this point, I wish to advise that we do not have nearly the experience possessed by the older and more established wire industries, such as steel and copper. I believe, however, that a discussion of our experience to date will be of value and interest, since we no doubt have encountered problems that are related to other wire-drawing industries.

* * *

In our plant, we start with ¼" diameter to ⅝" diameter hot-rolled annealed coils. These coils are carefully inspected for laps, seams, and other defects that subsequent drawing will not eliminate. In addition, the coils are analyzed for hydrogen content, since our experience has shown that a hydrogen level in excess of 80 ppm in these metals approaches the upper limit for satisfactory workability.

* * *

Titanium coils are descaled in a molten salt bath running at 850-1000° F. Subsequently, the coils are immersed in a hot sulphuric acid bath, then in a bath consisting of nitric and HF acids. Zirconium cannot be successfully descaled in the salt bath and, therefore, all surface cleaning is accomplished in these same acid baths.

* * *

After cleaning, heating in air is employed to produce a light surface oxide which improves adherence of the lubricant. In addition, a lime coating is usually baked on to serve as a carrier for the lubricant. Calcium or lithium stearate soaps with EP additives or, in some cases, moly-disulphide are used for lubrication. Colloidal graphite suspensions in proper vehicles and other coatings are also used. Basically, the problem of lubrication involves selecting a lubricant that will adhere to the wire, will not break down under the high temperatures developed in drawing, and can be removed readily after drawing.

* * *

Proper annealing, needless to say, is a very important step in successfully drawing titanium and zirconium. In our shop, pure titanium is heated to 1350° F, held ½ hour at temperature, and cooled in air. Titanium alloys, such as 4A1-4Mn and 6A1-4V are annealed at slightly higher temperatures and quenched in water. Zirconium and Zircoloy-2 are annealed ½ hour at 1250° F and cooled in air. Vacuum annealing is used if required by the customer's specification, or when the hydrogen content of the material reaches an undesirable level.

* * *

Tungsten carbide dies are used for essentially all drawing operations. Diamond dies are sometimes used for very fine wire. Die design is apparently an idiosyncrasy of the particular plant involved. Under the conditions in our plant, we find that short bearing dies with a low approach angle are most satisfactory. A significant change, however, in any of the other factors — particularly lubrication — might have a decided effect in our die design.

* * *

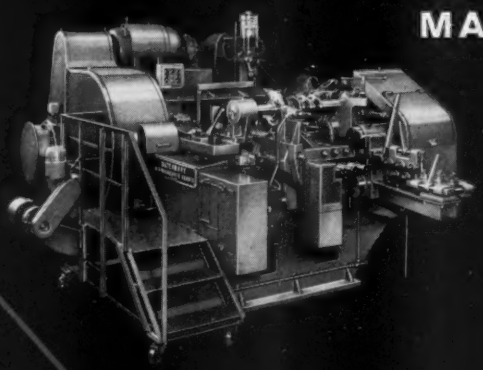
Fastener stock, which is ordered straightened and centerless ground, in sizes ranging from .196" to .320" actually makes up the bulk of our titanium business. Other titanium wire mills produce this type of product by centerless grinding hot-rolled stock to size; however, we cold draw before centerless grinding and find that this results in improved properties in the finished fastener stock.

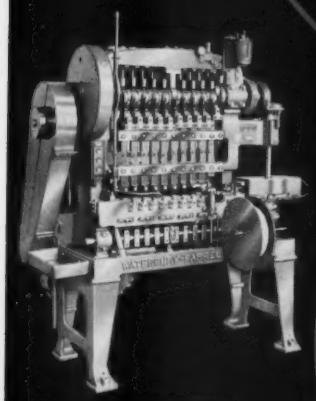
* * *

Every day the customers' requirements are becoming increasingly more stringent. In meeting these demands for higher quality, we are gaining excellent experience. Recent development work with new lubricants and dies indicate that we may soon be able to draw titanium and zirconium wire with heavier drafts and at least

(*Please turn to page* 1547)

COLD HEADING
MACHINERY





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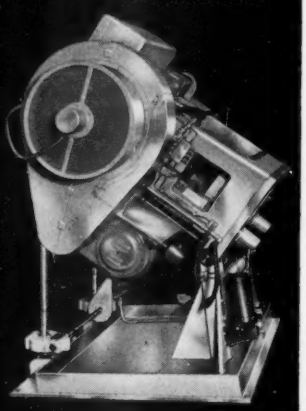
FARREL

POWER
PRESSES



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SLITTER
& WIRE
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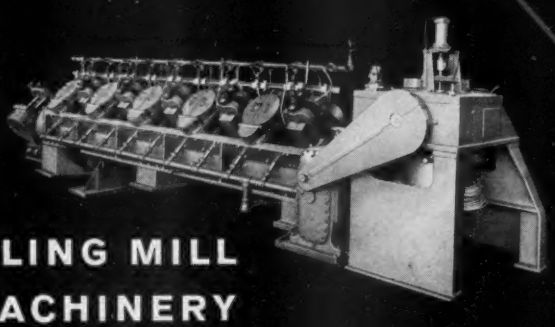

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WF-55

Weaving Wire Quality

Many types of woven wire products are covered in the broad field of wire fabrications. These include spiral belting, field and industrial fencing, netting of a number of types, wire cloth welded fabrics, and so forth.

* * *

Choice of materials depends upon the specialized uses, involving mechanical properties, such as elasticity, yield point, yield strength, tensile strength, ductility, toughness and brittleness.

* * *

Chemical and physical qualities are determined by customer requirements, and not necessarily by the fabrication processes, yet producers must give consideration to the latter, since some properties contribute to better quality and production costs, while having little effect on the finished product.

* * *

In bobbin and shuttle weaving, for example, the wire needs to be soft, smooth in finish, and uniform in size. Black fully annealed steel wire of an .06 to .08 carbon content has been found to be ideally suited to such weaving. Black annealed wire, being less slippery, lends itself to weaving in a uniform pattern. Where warp and fill wires are both crimped, a higher carbon content is desirable.

* * *

Major improvements have come into the wire cloth field recently, greatly emphasizing the need for quality wire.

Galvanizing Tip

The nature and amount of layers of the zinc-iron alloys are considered to be controlling factors influencing coating ductility and adherence. Thicker layers of these alloys are felt to be less adherent and galvanizing processes that produce few alloy crystals on the base steel yield coatings with good forming qualities.

* * *

It is important not to have residual iron left on the stock as a result of pickling or to allow newly formed rust on the rod or wire to be carried into the molten zinc. The freedom from such oxides reduces the formation of dross and improves the ductility and adherence of the zinc coating.

Readers are invited to send us how-to-do-it items for this department. For each item received that is published we will pay contributors $10.00. Your cooperation will be appreciated by us and our many readers. May we hear from you?

Ten-Mile Lengths of Unwelded Wire

Coils of phosphor bronze wire weighing more than 1000 pounds and containing a single strand measuring approximately 10-miles in length have been produced by **Riverside-Alloy Metal Div., H. K. Porter Company, Inc.** Special continuous casting techniques and equipment, exclusive with Riverside-Alloy in the United States, has enabled the division to add the new giant coil to their product line.

* * *

The new 1000 pound coils were produced primarily for the Fourdrinier industry. Manufacturers of these huge screens for paper making machines had long desired a coil of wire larger than the conventional 100 pound size. These giant coils are now saving Fourdrinier screen manufacturers countless production hours by slashing down-time.

* * *

First tested in 1958, the 1000-pound coils proved successful and were quickly put into full-scale production. In addition to the length

The new 10 mile coils present a striking contrast to regular size coils shown in the background. * * * * * * * * *

of the unwelded, one-piece wire strand, a definite quality improvement was noted. The special continuous casting equipment made possible a consistently dense homogeneous composition for all metal produced, eliminated the porosity inherent in most conventional casting methods and produced finished wire that is unusually sound.

Spring Winder for Maintenance

A useful little hand-operated spring winding device has been developed by the **Advance Car Mover Co.**, Appleton, Wisconsin, for making single or small quantities of springs.

* * *

The device will make right or left hand coils, tension, compression, or torsion springs with inside diameters of from ⅛ inch to 1¼ inch. Wire diameters accommodated can range from fine music wire up to 3/16 inches.

* * *

Clamped on a bench, it can make springs for maintenance or experimental applications. A pitch gauge regulates the distance between coils, which may be disengaged when winding compression springs.

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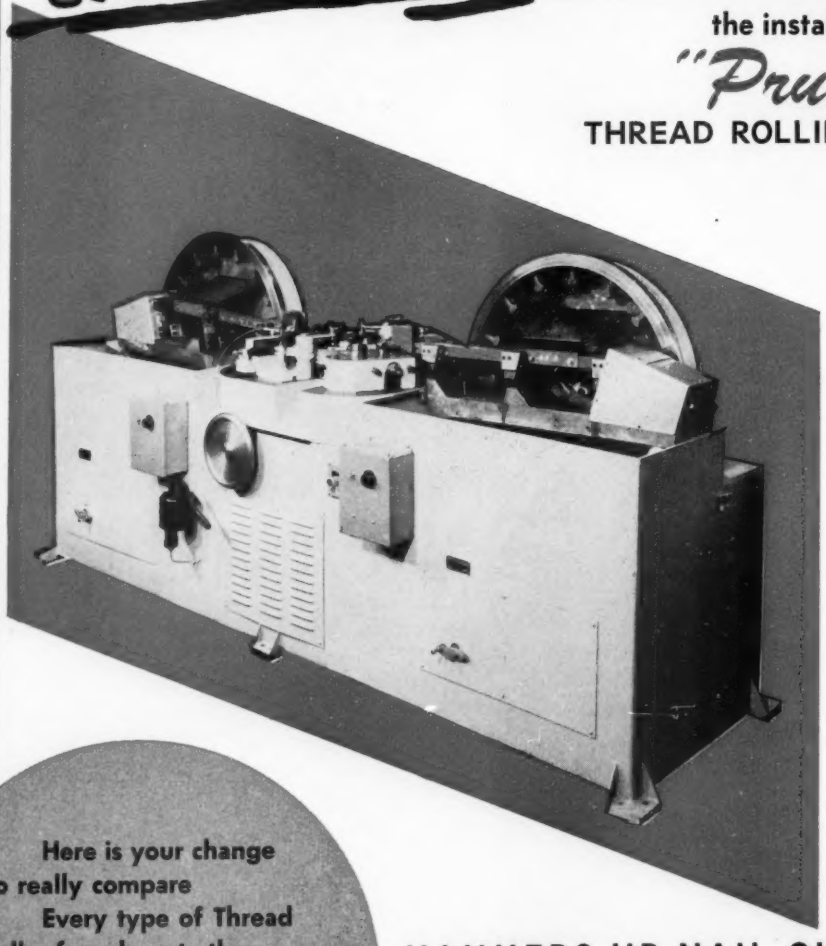

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Wire Kinks

savings and for complete flexibility in the springing of upholstered furniture backs is the new Kay-Bar, a new simplified unit announced by **Kay Manufacturing Corp.**, Brooklyn 1, N.Y. The Kay-Bar units are available with two or three coils and in varying heights, pressures and lengths.

* * *

Each unit can be installed by the use of only six small staples and can be supported equally well with strip webbing or with edgewire backing. The new Kay-bar, together with the firm's widely used Knife-Edge back units, enables the company to provide units with more flexibility to the springing of furniture and sectionals of all widths, especially to curved and round-the-corner pieces, inasmuch as Kay-Bar units can be spaced according to particular needs.

* * *

Most important feature of the new unit is its ability to hold up the edgewire forming the top line of the upholstered back without allowing any sagging. The firm will make a complete line of springs, spring assemblies, and accessories for the furniture industry.

—Courtesy of National Association of Furniture Manufacturers

Beryllium Copper

The addition of 1.80 to 2.1 percent of beryllium to copper produces some remarkable properties in wire—great strength, an ability function over wide ranges of temperature variations without change of characteristics, and resistance to fatigue—making the wire invaluable for such things as springs, although it has many applications.

* * *

As with most metals, annealing is required after reductions of 60 to 85 percent, if further drawing is to be done. The alloy derives its tensile strength mainly from cold working. The standard hardening treatment calls for heating annealed wire for three hours at a temperature of 600°F, or for two hours for cold drawn stock. This low temperature is easy to control and not critical as to time. It gives the highest strength and hardness.

Phosphate Coatings

The purpose of phosphate coatings on ferrous rod and wire is to interpose between the metal and the die a tenacious layer that serves as an added lubricant for the wire as it passes through the die.

* * *

Coatings are complex ferrous—ferrous phosphates and other mixed iron compounds produced by a chemical reaction with the metal, which ceases upon removal from the solution and rinse. The compound formed, however, remains firmly bonded to the metal, with dimensional, weight, and appearance changes only slightly different from that of the pickled steel.

* * *

The crystalline coating thus obtained has the ability to absorb and retain the usual drawing lubricants carrying them through the point at which deformation takes place.

* * *

Substantial improvement in die life, stepped up production, corrosion resistance and uniformity of appearance and quality result from the use of this added step in the preparation of rod for drawing.

Water and Wet Copper Drawing

The behavior of wet lubricants depends to a marked extent on conditions encountered in a mill, as few mills have the same equipment, lay-out and conditions. Water, for example, may vary within fairly narrow limits, but since wet drawing lubricants contain over 90 percent water, its "hardness" may vary from 0 to 600 parts per million.

* * *

Water softened by the common municipal process usually results in a hardness of 75-90 parts per million, with an alkalinity in terms of pH of 9.5 to 10.25. Where mills are not able to use municipal water, it is commonly softened by the zeolite principle, but if very hard water has been softened to the saturation point by going through this system, precipitation of the soap may result, the stability of the fat emulsion may be affected, and a clogging of dies often is experienced.

* * *

It is desirable to use a continuously softened water rather than batch softening or the adding of a softener to the lubricant. Sometimes water is polluted by acid. For this reason periodic pH tests should be made to make sure that the water has a pH of 8.5 to 10 — a satisfactory lubricant range. Too low a pH will cause an excessive formation of copper soap, which gums dies and clogs pipes. Too high a pH is equally bad, resulting in poor lubrication and excessive die wear.

* * *

In freshly made up solutions the pH is at its peak, but this drops as the lubricant is used, largely due to the presence of carbon dioxide in the atmosphere. The reverse may take place under certain conditions, as when the rate of drawing wire is great in relation to the

(*Please turn to page* 1543)

Production and Laboratory Control of High Quality Polyvinyl Chloride Compounds for Wire and Cable Insulations and Jackets

by Quentin R. Ball
Assistant Superintendent, Cable Engineering Laboratories
Wire and Cable Division
Northern Electric Company Ltd.
Lachine, Quebec, Canada

The rapid growth during the past fifteen years in the utilization of plastics has resulted in these materials achieving a position of importance second only to copper in the wire and cable industry. Figure #1 shows this growth — relating pounds of thermoplastics to pounds of copper used. The wire and cable industry has long been one of the largest users of copper and it is now one of the largest users of thermoplastics. Accordingly, progressive management in this industry has been prompted to investigate the advantages of mixing these compounds in their own plants, as has been the case with rubber for many years.

In-Plant Mixing

Although a diversified cable plant utilizes most of the plastics in general use to-day — polyvinyl chlorides, polyethylenes, polyamides and polyesters, polyvinyl chloride compounds for extrusion are the first group considered for in-plant mixing. This is because, unlike most other plastics, the characteristics of the final compound result mainly from the admixture of a number of other ingredients to the resin. This can be done equally well away from the polymerization plant. Using an electrical grade of PVC resin, the large spread of properties available depends upon the types of plasticizers, fillers and stabilizers used.

* * *

The mixing of these PVC compounds in the electrical cable plant offers a number of attractive features. These include economy of manufacture, improved flexibility of operation while inventories are reduced, lower handling charges, opportunity for the development of ones own compounds and direct control over the actual compounding process.

Quentin R. Ball

Mr. Ball received an engineering degree from the University of Toronto in 1940 and immediately joined the Northern Electric Company. Since then, with the exception of the period of 1945 and 1946 spent at the Massachusetts Institute of Technology doing post graduate work, he has served in various engineering capacities. He has been in charge of their Cable Engineering Laboratories since 1952. He is a registered professional engineer and a member of several engineering societies.

This paper was presented at the Annual Convention of The Wire Association on October 14, 1959, in Cleveland, Ohio.

* * *

Polyvinyl chloride compounding processes are of two general types — one wherein the materials are mixed hot in a fluxed state, as occurs in banbury mixing, the other where the ingredients are thoroughly mixed in an unfluxed state, usually at a temperature just below the fluxing point. The latter method is referred to as dry blending. A comprehensive evaluation of the various types of equipment which may be employed for this process was given in a paper by **M. G. Caine** (1) before The Wire Association at the Annual Convention in 1952.

Choice of the Process

The dry blend process has certain advantages over the melt mix process, one of the more important advantages being that the lower heat history obtained with the dry blend process results in final insulations with better electrical properties. However even with the dry blending processes the heat history can vary depending on the method used and the controls maintained. This was one of the factors which, in our case, led to the selection of a mullor type blender. With this equipment there is an intensive mixing of relatively small batches of compound during a short cycle and there is a uniform heating of the ingredients during the mixing as is shown in Figure #2.

* * *

The exceptionally good dispersion of the compound ingredients obtained in the mullor mixer is due to the "shearing" action of the mullor wheels on the compound which is held in the shape of a doughnut around the side of the bowl. This intensive mixing with the resultant good dispersion produces very uniform compounds and no further mixing to obtain improved dispersion is required or advisable. Figure #3 shows the principle on which the mullor type

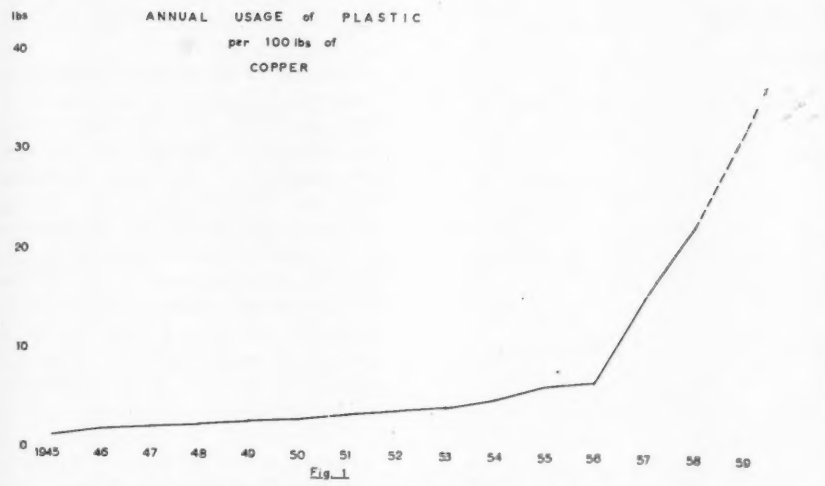

Figure #1 Annual Usage of Plastic per 100 pounds of Copper

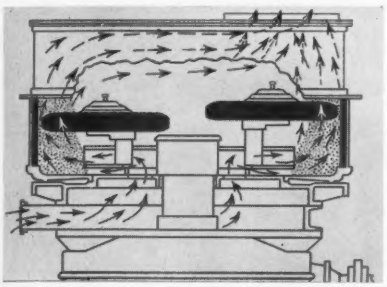

Figure #2 — Diagram of Heat Flow inside Speedmullor. Flow of air indicated by arrows can be varied in temperature. Powder position shown in dotted areas. Diagram courtesy of Beardsley & Piper Div., Pettibone-Mulliken Corp.

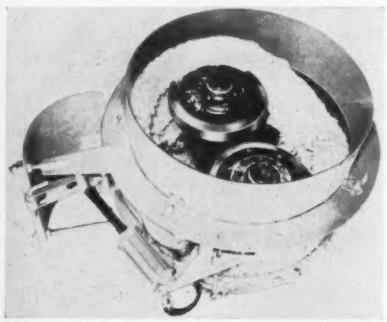

Figure #3 — Interior view of Speedmullor Bowl. Mixing is done by a mulling action of 2 internal wheels against the walls. Courtesy of Beardsley & Piper Div., Pettibone-Mulliken Corp.

mixer operates.

* * *

Another quality feature of this type of mixing procedure is the elimination of the human element with the exception of the weighing of some of the ingredients. In the operation of the machine, as shown in Figure #4, the operator empties bag quantities of resin, and weighed quantities of fillers and stabilizers into the skip hoist. At the start of a cycle the skip hoist dumps this charge into the mullor bowl, the mullor wheels being continuously in motion. After a definite controlled heating cycle, wherein air is admitted at 380°F, the correct amount of plasticizer(s) is automatically metered into the mixing chamber and mixing continues to the end of the cycle. When the mixing is complete the discharge door opens and the mullor wheels push the material into a receiving hopper. The time of additions and the length of the cycle are predetermined and set on a master control panel. These factors are thus not dependent on variations of the operator. This procedure has the additional advantage that it adapts itself to the development of a continuous operation with the attendant quality feature of freedom from contamination if done in a "closed" continuous system.

Evolution of the Process

With our initial installation it was planned to utilize the dry blended compound directly in extruders with extended cylinders. However, it was found that such a procedure had certain restrictions. The extrusion of dry blended compounds in non-vented extruders resulted in extrusion rates being restricted to wire line speeds such that the worm speed did not exceed 45 RPM. Worm speeds in excess of this gave porous insulations due to the entrainment of air. Although it was proven that such insulations were equivalent electrically to solid insulations, most specifications specifically exclude the use of insulations which show evidence of porosity. This is because porosity can also result from the evolution of hydrogen chloride when a polyvinyl chloride resin is heat degraded. Rather than try to correct this condition at each extruder the obvious solution was to correct the problem when the compound was made. Ideally, this is done by fluxing the dry blend with a minimum of heat and for a minimum length of time. To do this an 8½" extruder equipped with a constant pitch worm with a compression ratio of 3.5:1 was placed in series with the Speedmullor and the exudate from this, after cooling, was run through a step and stair dicer to provide a compound in cube form. In this process the dry blend was conveyed from the mullor to the extruder hopper by an air conveyor. This equipment worked well with one exception — the compound so produced was also porous. The trouble was traced in this case to the air conveyor system. The use of air which, during humid summer weather, contained considerable moisture resulted in the dry blend absorbing this moisture while being conveyed. Since it was being fed directly into an extruder

Figure #4 — Photograph of the Speedmullor.

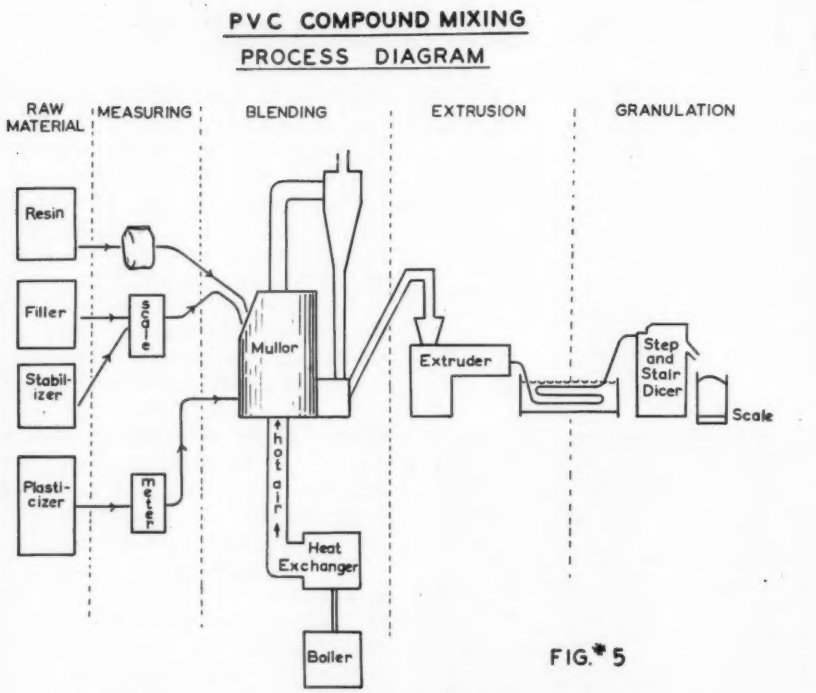

Figure #5 — PVC Compound Mixing-Process Diagram. * * * * * * * *

it also was unnecessarily cooled during this transfer. The replacement of the air conveyor with a bucket type conveyor resulted in dry hot powder compound being fed to the extruder and the porosity trouble was eliminated.

* * *

The manufacture of PVC compound in the form of cubes by this sequence resulted in the evolution of a most efficient continuous process as shown diagramatically in Figure #5. One operator per shift handles the complete manufacture of PVC compounds from the loading of the raw materials to the filling and weighing of drums. This latter operation is arranged so that when 190 pounds of compound is loaded into a drum a bell rings to notify the operator so that he can change drums when they contain exactly 200 pounds. This weighing simplifies subsequent addition of color concentrates since the drums to be colored all contain the same amount of compound. Outputs of 1000 to 1200 pounds per hour of compound are obtained. As the process requires only one man per shift for the complete operation, the labour cost per pound is low. Several millions of pounds of compound have been manufactured in our plant since the installation of this equipment in 1955. The amount of rejected compound has been negligible — less than .001%.

Some Details of the Process:

Safety Precautions

It was evident from the start that the exclusive use of lead stabilizers in electrical grade compounds necessitated definite precautions to protect the operators from lead poisoning. The lead stabilizer is loaded into a storage bin by an operator equipped with a dust respirator. This bin is under the same exhaust hood as the weighing scale. The skip hoist hopper is exhausted during the charging of the hopper and during the dumping of the material from the hopper into the mixer. The mixer is exhausted to a cyclone separator so that fines do not escape into the atmosphere. Semiannual medical examinations are made on all personnel involved and periodic checks are made on the lead content of the air to ensure that all the exhausting devices are operating properly. The recommended safe maximum concentration of lead in air is 1.5 mg per 10 cubic meters. With our arrangement the concentration is less than 0.5 mg per 10 cubic meters.

* * *

A boiler charged with Dowtherm E heats the heat exchanger through which the air which heats the charge is passed. Because of the dangers of operating a boiler with an inflammable fluid which is toxic, the boiler is housed in an annex to the main building. As the decomposition products of the Dowtherm are also toxic and attack the metal of the boiler a number of safety devices were installed to ensure safe operation of the boiler.

* * *

These safety controls include a Low Level Control which stops the gas supply to the burners and sounds a warning hooter should the level of Dowtherm in the boiler drop below a safe minimum liquid level. Also provided is a High Pressure Control which, at a pressure 10 lb. per sq. inch above the normal operating pressure, cuts off the gas supply to the burners. As an extra precaution there is a rupture disc and a safety valve to protect personnel and the boiler. A High Temperature Control stops the gas supply to the burners should for some reason the temperature rise 70°F above normal operating temperatures.

Maintenance of Equipment

After every three months of operation the boiler is shut down and subjected to a rigorous maintainance schedule. Four times yearly samples of the Dowtherm E are analysed for evidence of decomposition.

* * *

The mullor unit is thoroughly cleaned every month. This removes any material which might become lodged in the mixing chamber. Maintainance costs on the equipment approximate 0.001c per pound of compound produced.

Versatility of Process

Our installation was originally set up to produce only a limited number of our large usage compounds. All of these compounds utilize DOP (di-2-ethyl-hexyl phthalate) as the only plasticizer. With the extension of the process to mix a variety of compounds, auxiliary

tanks were added so that other plasticizers could be used. Semi-rigid compounds with a plasticizer content of 23% and soft compounds with a plasticizer content up to 60% have been successfully run. To prevent the wrong amount of plasticizer from being added a double metering system is used, the second stage shutting off the mullor if the incorrect amount of plasticizer is admitted. This equipment does have restrictions in the manufacture of compounds utilizing certain polymeric plasticizers due to the difficulty of dispersing these plasticizers in the short cycles utilized.

Compound Control and Development

The first part of this paper concerned the production aspects of mixing PVC compounds utilizing a continuous line based on a Speedmullor type of mixer. The second part of the paper concerns the laboratory work and inspection routines which provide the background for the successful operation of such a process.

* * *

Any compound is only as good as the raw materials it contains, therefore the purchase of materials to explicit specification is important. With plasticizers, requirements such as refractive index, dissipation factor and volume resistivity are specified and each shipment is inspected to ensure that it meets the levels established. With the Speedmullor it is especially important that the right type of resin be utilized. Although many manufacturers of PVC resin have developed special grades for dry blending, in our Cable Engineering Laboratories we have found that, by a series of tests, it is possible to select certain of these resins which will perform more satisfactorily than others. By this selection it is possible to choose resins which will mix into a dry blend compound and be capable of extrusion at higher rates in the fluxing extruder to produce compounds with no porosity. From the dozens of dry blend resins available today, only a limited number meet these requirements which are based on flow rate, angle of repose and particle shape. As an example,

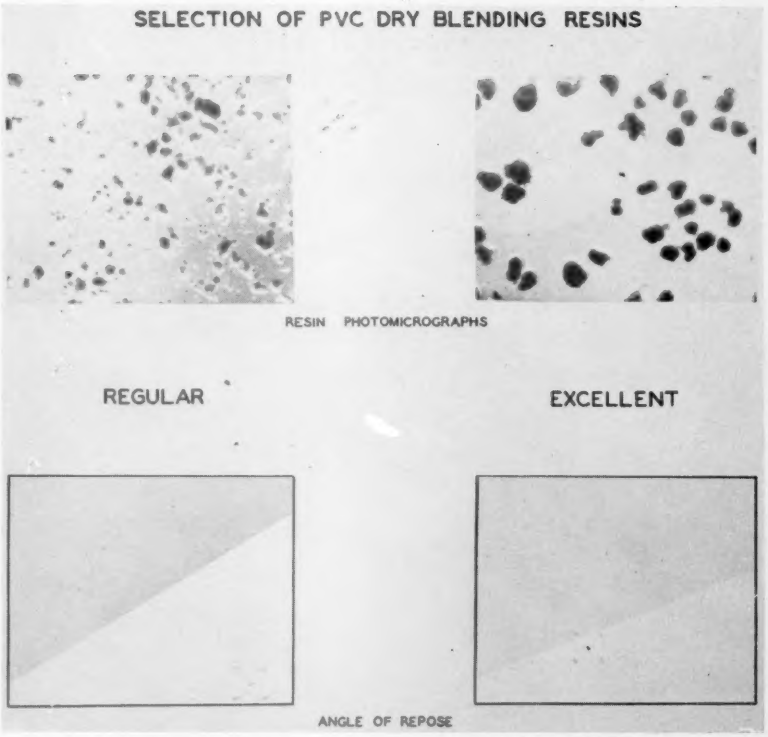

Figure #6 — Selection of PVC Dry Blending Resins. * * * * * * * * *

Figure #6 shows the angle of repose and particle shapes of an excellent and an ordinary resin.

* * *

The laboratory also evaluates various fillers, plasticizers and stabilizers for insulating and jacketting compounds. Various plasticizers and Plasticizer combinations have been evaluated to check their solvent power, heat and light stability and electrical properties. Recently **R. G. Kodesch** (2) outlined vinyl plasticizer development and some of our laboratory work has been parallel to several of the points mentioned in this article. However most of a wire and cable laboratory's work in this area is related to evaluating the various commercial plasticizers available to determine their effects in compounds to obtain improved characteristics when exposed to temperature extremes or adverse environments. Similarly on fillers, work is directed at the evaluation of commercially available fillers to determine what types and loadings are best to obtain easy processing compounds with good physical and electrical characteristics, good heat and light stability and good aging properties. Frequently the use of a more expensive material results in a lower cost extruded wire since extrusion rates may be improved. However in studies of this type it is important to realize that any one property is influenced by many factors and the relative effect of each factor is dependent on the conditions selected to represent the other factors. This point was made by **J. G. Hendricks** and **N. L. Cooperman** (3) in their paper on the stabilization of PVC insulation. The important result is the overall properties of the developed compound. These properties are best evaluated by the actual extrusion of the compound on wire and then subjecting the finished product to an exhaustive evaluation. In our laboratories this is done on a 2½" laboratory extruder equipped with automatic temperature recording of four zones in the extruder barrel and head. Cooling water to the worm and trough can be supplied at any preset temperature desired. The wire can be electrically preheated and the extrusion pressures are indicated. Thus not only is wire produced for evaluation but optimum extrusion conditions can be ascertained. Evaluation of the

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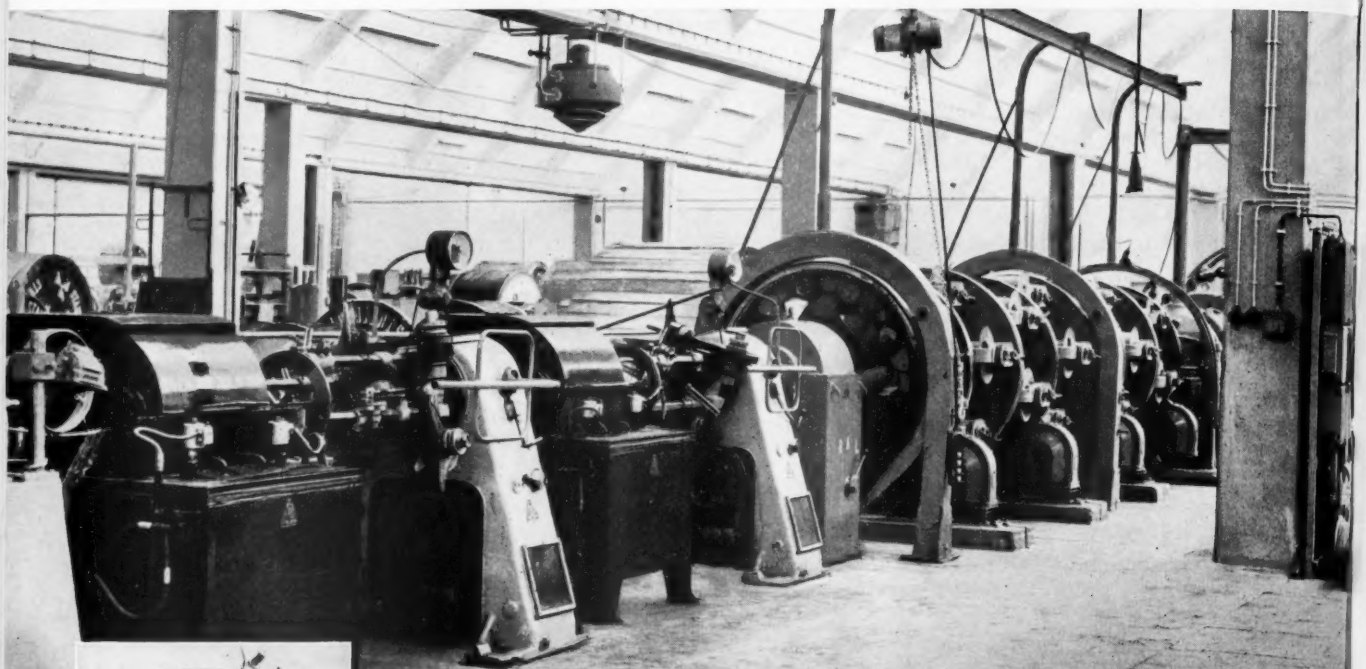

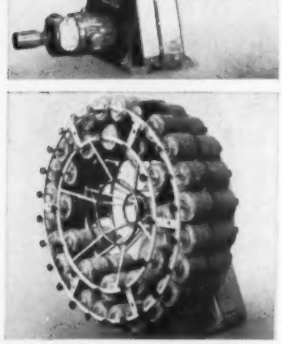

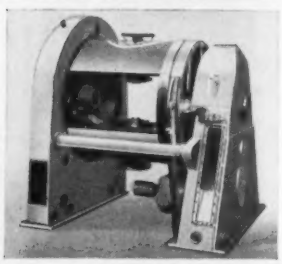

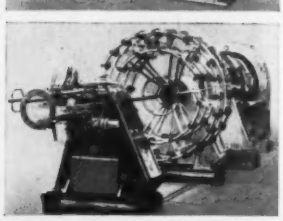

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Recent Developments in Aluminum Alloy Wire

by Charles L. Kessler
Chief Works Metallurgist
Massena Fabricating Works
Aluminum Company of America
Massena, New York

Of the many aluminum alloys produced in the form of aluminum wire products, two are particularly popular because of their range of strength and ductility.

* * *

One is a non-heat-treatable alloy containing a nominal 5%Mg—designated 5056—and the other is a heat-treatable alloy containing a nominal of 1% Mg, 0.6% Si and 0.25% each of Cu and Cr— designated 6061. The minimum guaranteed mechanical properties developed by these alloys are illustrated in Figure I. Ductility decreases and strength increases with the introduction of cold work by drawing these alloys from annealed temper stock. A wide range of strength is developed in 6061 alloy also by drawing various amounts following solution and precipitation heat treatment.

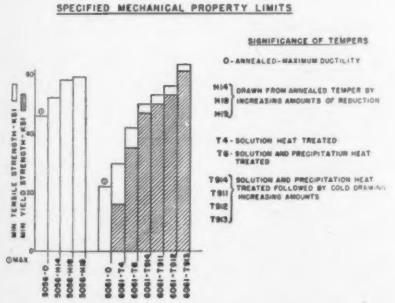


Figure I — Specified Mechanical Property Limits — 5056 and 6061 * * * * * *

These ranges of properties explain the successful application of 5056 wire for the manufacture of slide fasteners, woven architectural grids, knitting needles, spiral reinforcing for hose, and staples for tea bags. The tensile strength of the hard drawn tempers of aluminum alloys containing magnesium will decrease at room temperature for periods of 18 months to two years. Stabilizing accomplishes this same change in properties in a matter of hours at an elevated temperature. For example, where improved ductility is required for forming the intermediate and hard drawn tempers of 5056 wire, the finished wire is stabilized by heating for one to four hours at 250 Degs. F. This thermal treatment results in a decrease in ultimate tensile strength of about 5% with a marked improvement in forming characteristics. (Figures II, III, IV illustrating applications).

* * *

The heat-treated and cold worked tempers of 6061 alloy are being successfully employed in the manufacture of preformed armor

Charles L. Kessler

Following graduation from Rensselaer Polytechnic Institute, the author started with ALCOA at their Edgewater Works. He has handled assignments in production planning, estimating, melting and rolling operations and metallurgical control, development and customer's service in sheet, plate, foil, impact extrusions, collapsible tubes, screw machine products, fasteners and anodizing. During the last four years he has held his present position at the Massena Fabricating Plant, where Wire, Rod, Bar, Structural Shapes, Conductor — bare and covered — and conductor accessories are produced.

Mr. Kessler is a member of The Wire Association, American Society for Metals, American Society for Quality Control, and the American Society for Testing Materials.

This paper was presented at the Annual Convention of The Wire Association on October 13, 1959, in Cleveland, Ohio.

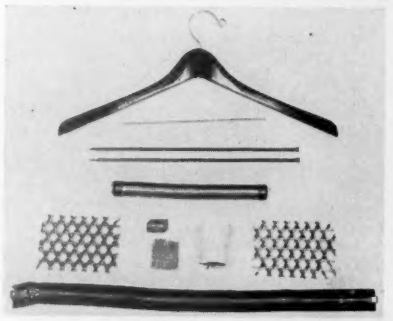


Figure II — Applications for 5056 Wire * *

Figure III — Anodized Architectural Grid Room Cooler * * * * * * * *

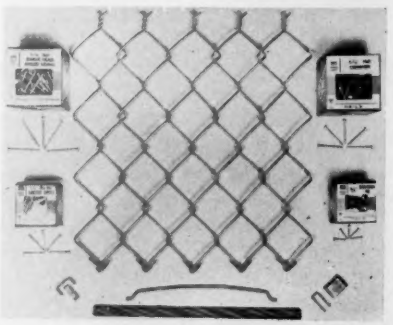


Figure IV — Applications for 6061 Wire * *

rods, handles for restaurant cooking utensils, spring-type hinge pins, chain link fence and nails. (Figure V illustrating applications).

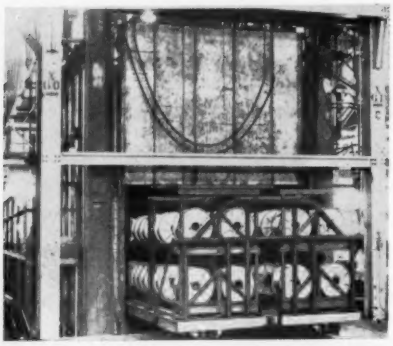


Figure V — Protective Atmosphere Furnace — Load being charged * * * * * *

A pleasing appearance is an essential characteristic of articles manufactured from aluminum alloy wire. The wire supplier must be prepared to assist the trade by employing wire fabricating proceddures that permit achieving the desired surface finish. Both clear and colored anodic finishes are becoming increasingly popular as a means for gaining sales appeal. A chemically clean, smooth, lustrous surface is required for this type of finish. These essential characteristics are provided by the wire supplier utilizing the following techniques.

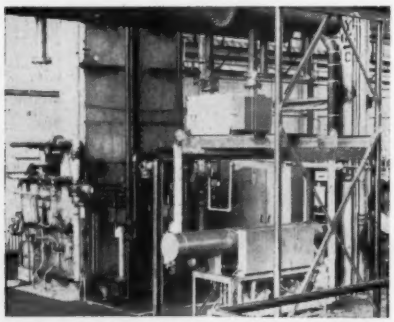


Figure VI — Protective Atmosphere Furnace — Gas Producer * * * * * * * * *

Protective atmosphere annealing is employed to prevent the formation of objectionable oxide discolorations and eliminate the occurrence of lubricant stains. This method of annealing results in the formation of less surface oxide than annealing with ordinary atmospheres. (Figures V & VI).

* * *

Intermediate wire shaving removes objectionable surface oxides and embedded foreign particles accumulated during prior processing. Cold reduction following shaving produces a smooth, lustrous surface suitable for anodic finishes. The wire is guided into the shaving head through one or two lead dies to insure uniform depth of removal. The chips are fragmented by means of a breaker which is an integral part of the shaving head. With adequate cooling and lubrication, speeds in excess of 1000 FPM can be employed. One or more dies are utilized following shaving to insure centering of the wire in the shaving head. (Figure VII—A & B)

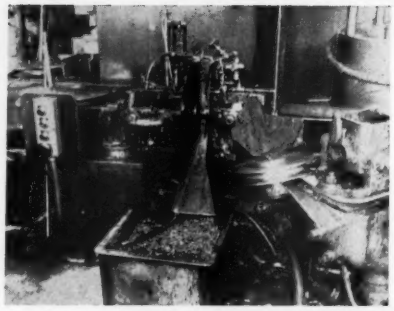


Figure VIIA — Photograph of Wire Shaving Machine * * * * * * * * * * *

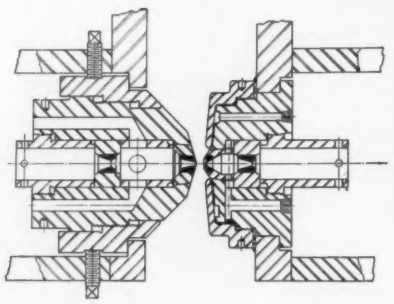


Figure VIIB — Diagramatic Sketch of Wire Shaving Machine * * * * * * * *

* * *

In wire sizes where shaving cannot be readily employed, intermediate chemical cleaning of the surface prior to final drawing achieves similar results. A rapid etching, caustic type cleaner followed by acid and water rinses provides the desired results. (Figure VIII). As a means of control of the process, an end of a wire of each load is taped to prevent etching, thus permitting the measuring of the amount of metal removed.

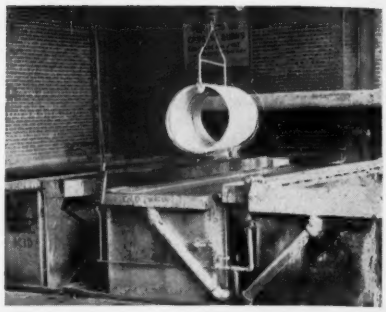


Figure VIII — Chemical Cleaning * * *

Accurate control is essential to the success of the intermediate shaving and chemical cleaning operations. Anodizing random samples following these operations indicates whether the surface has been adequately cleaned. (Figure IX). This routine production test assures the rigid standards necessary for anodic finishes.

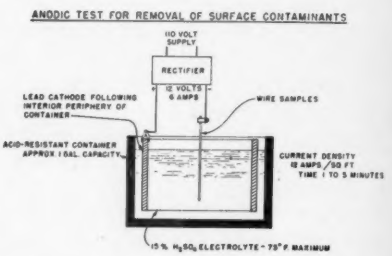

ANODIC TEST FOR REMOVAL OF SURFACE CONTAMINANTS
110 VOLT SUPPLY
RECTIFIER
12 VOLTS 6 AMPS
LEAD CATHODE FOLLOWING INTERIOR PERIPHERY OF CONTAINER
WIRE SAMPLES
ACID-RESISTANT CONTAINER APPROX. 1 GAL. CAPACITY
CURRENT DENSITY 12 AMPS./SQ. FT. TIME 1 TO 5 MINUTES
15% H_2SO_4 ELECTROLYTE - 75° F. MAXIMUM

Figure IX — Anodic Test for Surface Contaminants * * * * * * * * * *

These precautions do not eliminate the need for mechanically or chemically brightening the surface of the finished parts to remove tool and handling marks prior to anodizing. Manufacturers of aluminum alloy wire products should always consult their nearest ALCOA representative to be certain they are purchasing the product best suited for their finishing operations.

* * *

Basic research conducted by the ALCOA Research Laboratories and applied research under the supervision of the Metallurgical Engineering Division in the fabricating plants has been the successful answer to fulfilling customers' needs in a rapidly expanding market. Knowledge developed by these groups led to the conclusion that EC wire could be produced with a minimum conductivity of 62.0% instead of the present industry standard of 61.0% at 25 Degs. C.

Precise control of the composition of metal combined with the addition of boron* results in an EC alloy that can be fabricated into even —H19 temper wire with a minimum guaranteed conductivity of 62.0% of the International Annealed Copper Standard at 25 Degs. C.

* * *

Alloy 1345 has been specifically developed for the manufacture of color anodized shelves for domestic refrigerators. This product is offered as shelf wire in the form of 200-lb. spool-wound coils. The development of this product has resulted in the manufacture of better looking, lower cost refrigerator shelves than is possible with competitive metals. (Figures X, XI, XII, XIII).

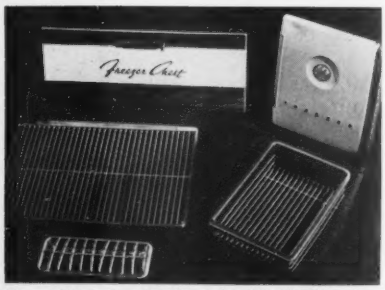


Figure X — Applications for Shelf Wire * *

Figure XI — Applications for Shelf Wire * *

* * *

Jewelry items fabricated from X5405 alloy wire are illustrated in Figures XIII and XIV.

* * *

Assurance of performance for all wire products is provided customers by rigid manufacturing control, inspection and testing to substantiate conformance to purchase specifications for ultimate tensile strength, yield strength, or minimum elongation.

* U. S. Patent 2,545,866 assigned to Aluminum Company of America.

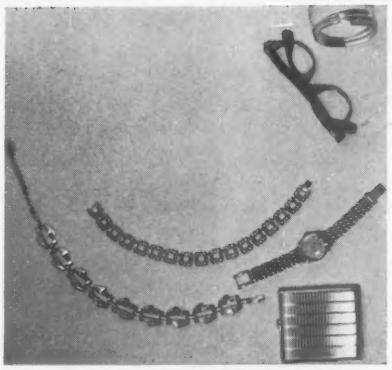


Figure XII — Costume Jewelry * * * *

Figure XIII — Costume Jewelry * * * *

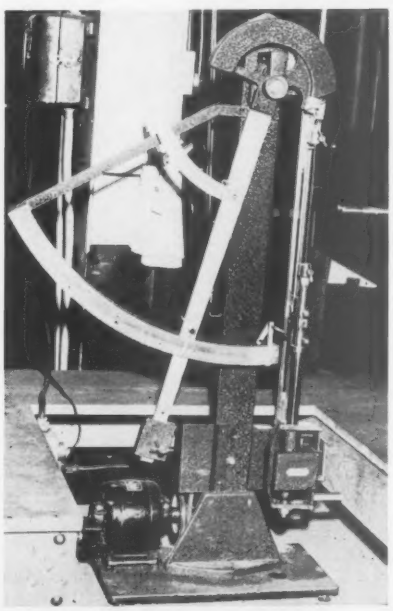


Figure XIV — Fine Wire Testing * * *

The temper of non-heat-treatable alloy wire products is defined by ultimate tensile strength. Wire sizes of .125″ diameter and larger finishing in the annealed temper are also defined by minimum elongation. This applies to both the non-heat-treatable and heat-treatable alloys.

* * *

Heat-treated tempers of wire alloys are defined by ultimate tensile strength, yield strength and minimum elongation for all sizes of .125″ diameter and larger. Smaller sizes are defined by ultimate tensile strength only.

* * *

Equipment for performing these tests is periodically inspected and calibrated by representatives of ALCOA Research Laboratories using instruments which have been calibrated against U. S. Bureau of Standards equipment.

* * *

An example of the equipment employed for tensile testing is a specially designed unit generally employed for .025″ diameter and smaller wire. This unit has two operating ranges: 0—15 lbs., and 15 lbs.—75 lbs. breaking strength. Although elongation is not required in wire below .125″ diameter, this unit is capable of automatically determining the elongation in 10″. (Figure XIV.

* * *

Larger sizes of wire are tested on units capable of exerting tensile loads of 0—1000 lbs., 1000 lbs. —5000 lbs., and 5000 lbs.—20,000 lbs. Such equipment employs strain followers for producing graphs for the determination of yield strength by the 0.2% offset method. Figure XV).

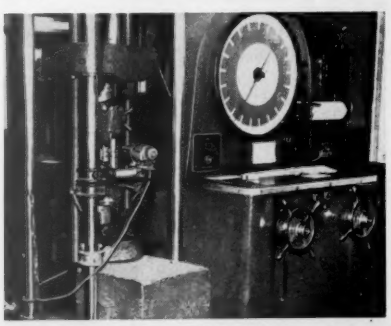


Figure XV — Large Wire Testing * * *

Facilities have also been specifically developed for testing

(*Please turn to page* 1552)

THE ELECTRIC WIRE & CABLE SECTION OF

THE WIRE ASSOCIATION

The Association has been interested in and has had electric wire and cable men as members throughout its 30-year existence. During the period this membership has grown steadily and the service of the Association has developed correspondingly. It had reached a point where a special section to serve their interests became necessary and so this Section was organized in response to calls to fill the need for a common meeting-ground for production men.

The purpose of the Section is to disseminate the technical and practical information required for the production of Electric Wire and Cable. Men in the mills concerned with production problems, working with and through the Committee may now hold regional meetings devoted wholly to their interests and have programs during the Annual Convention concerned only with their problems.

The Committee began to function in 1958 and the full impact and value to the industry became fully effective at the Spring meeting of the Section at Boston and at this, the 1959 Annual Convention.

The Committee

The Electric Wire and Cable Section Committee, comprised of nineteen members, is listed below:

Clement C. Lawson (Chairman)
Plant Facilities Engineer
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

Harold W. Adams, Prod. Supvr.
Cable Div. Reynolds Metals Co.
2500 So. 3rd St.
Louisville 1, Ky.

David Barr, Plant Eng.
National Electric Div.
H. K. Porter Co.
338 14th Street
Ambridge, Pa.

Grover W. Brown, Mgr., Machinery Development
The Okonite Co.
Passaic. N. J.

G. E. Forsberg, Vice-President
Surprenant Manufacturing Co.
172 Sterling St.
Clinton, Mass.

Charles M. Fredrickson, Tech. Dir.
Southern Electrical Corp.
P. O. Box 989, Chattanooga, Tenn.

James S. Higgins, Plant Eng.
Walker Brothers, Copper Div.
Conshohocken, Pa.

R. W. Higginbottom, Chief Cable Eng.
Triangle Conduit & Cable Co.
P. O. Box 711
New Brunswick, N. J.

Alexander A. Kerr, Supt.—Prodn.
Electrical Wire Div.
John A. Roebling's Sons Corp.
Trenton 2, N. J.

C. L. Kessler, Chf. Works Met.
Aluminum Company of America
Massena, N. Y.

Urbain J. H. Malo, Technical Dir.
Narragansett Wire Co.
341 Pawtucket Ave.
Pawtucket, R. I.

W. R. Moyers, Chief Eng.
Wire Engineering Dept.
Western Electric Co.
P. O. Station B
Buffalo 7, N. Y.

J. C. Murray, Jr., Vice-President
Crescent Insulated Wire & Cable Co.
319 N. Olden Ave.
Trenton 5, N. J.

Sidney Rolle, Cons. Met. Eng.
32 Snowden Lane
Princeton, N. J.

D. M. Schmid, President
Techalloy Co., Inc.
Rahns, Pa.

Philip H. Snyder, Plant Mgr.
Wire and Cable Div.
The Electric Auto-Lite Co.
601 Poplar St.
Hazelton, Pa.

H. S. Spaulding, Tech. Supt.
Kaiser Aluminum & Chemical Corp.
P. O. Box 671, Newark, Ohio

Roger T. Stafford, Project Engineer
Kennecott Wire & Cable Co.
Phillipsdale (Rumford 16), R. I.

Marshall V. Yokelson, Chief Met.
General Cable Corp.
Bayonne, N. J.

Details concerning the activities of the Section will be reported as they develop.

THE WIRE ASSOCIATION

RICHARD E. BROWN, *Executive Secretary*

453 MAIN STREET **STAMFORD, CONN.**

GILLIES CONCAVE AND FLAT MARKING WHEELS PRINT YOUR

Heat Treat Review

Color cover of "Heat Treat Review" shows one of the two Surface continuous bright annealing furnaces at **Scovill Manufacturing Company's** new tube mills at New Milford, Conn. Each furnace is designed to handle tubing up to sixty feet in length on a full production basis.

* * *

The lead article tells how a manufacturer of precision dies gets better surface finish and insurance of maximum life to the finished product. Modern heat treating equipment has eliminated the damage to threaded products previously caused by manual handling.

* * *

Other articles cover a screw manufacturing operation that produces 21 million nuts, bolts and screws per day. Two belt furnaces are used to treat a variety of 40,000 different parts in which practically every standard grade of steel is used.

Request copy of Heat Treat Review, Volume 10, No. 1, from **Surface Combustion Corporation**, Toledo 1, Ohio.

New Plastic Tube and Insulated Wire Printer

A new plastic tube and insulated wire printer has been developed by **The Acromark Company**, 423 Morrell St., Elizabeth, N.J., that accurately prints in color by a patented friction method at speeds up to 300 feet per minute and repeats the markings at 9" intervals.

* * *

Built for continuous production, this new machine, Model No. 482, incorporates an adjustment lever for varied cable sizes or tube diameters and flattened thicknesses. Friction created by passing the cable or tubing partially around pressure and rider rolls, operates the machine which prints from an enclosed printing roll that is partially immersed in the automatic inking fountain.

* * *

Overall size is about 10" by 8" x 7" deep including the flanged base. For further details, write the manufacturer.

Bulletin On Electrical Insulating Materials

This bulletin — GET-2929, 12 pages — describes in text, tables and pictures, the characteristics and application range of insulating materials for electrical insulation systems. It includes technical data on available products including mica mat, varnished cloths and papers, insulating varnishes, wire enamels, "Irathene"* irradiated polyethylene, sealing and filling compounds, insulating finishes and adhesives.

* * *

For a copy, write **General Electric**, Schenectady 5, N. Y.

* **Registered Trademark of General Electric Company.**

Salt Bath Transformer Service

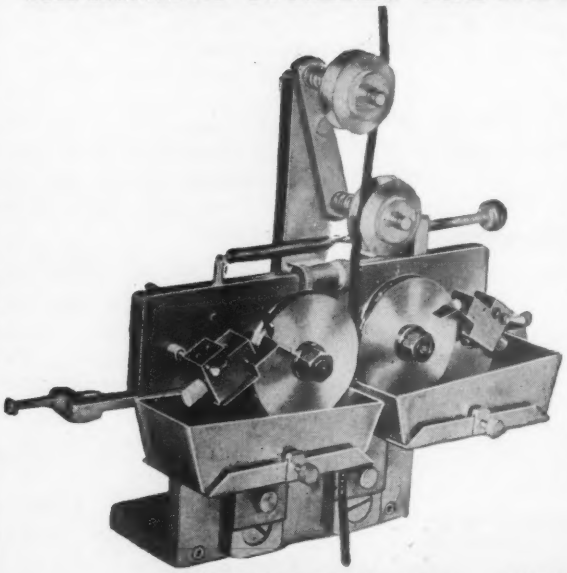
If the spark of life in that old salt bath transformer has finally burned out, think twice before tossing it on the junk heap.

LEGEND LARGE AND CLEAR ON INSULATED WIRE SURFACES ——— USE GILLIES MARKING

GILLIES CONCAVE AND FLAT MARKING WHEELS PRINT YOUR

WHEELS AND MACHINES FOR BEST WIRE IDENTIFICATION

MARKING WHEELS and MACHINES for ELECTRIC WIRE



Gillies Engraved Concave and flat marking wheels are widely used printing the I.P.C.E.A. color code, numerical, semi-spiral striped, dating, or manufacturer's identification, etc. on insulated wire, tubing or hose.

Machines print on ONE or BOTH SIDES in large legible letters. Wheels are adaptable to any machine—or we will supply the machines.

Wheels, shafts, ink pans and all accessories are readily removable for quick and easy cleaning.

Wheels are made of TOOL STEEL, HARDENED to Rockwell test 61-64 and HARD CHROME PLATED.

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CLOSING DATE FOR LISTINGS: JAN. 20th

Send us your changes on product listings and addresses just as soon as you can. The 1960 Edition of the WIRE AND WIRE PRODUCTS BUYER'S GUIDE is now being edited. Get these in to us.

ADVERTISING

It is also important that your advertising in this valuable reference directory be planned at an early date — even though we have advanced the closing date to February 20. Early advice enables us to serve you better.

By reinforcing your product listings with informative advertising, you help your prospective customer to arrive at a decision in favor of your products.

Directory advertising is effective because it emphasizes an advertiser's products and services at a time when a mill is in the market to buy.

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More often than not, a defective coil is at the bottom of the trouble. Perhaps a few replacement parts and a rewinding job are all that's needed to make a dead transformer operate as well as it did the day it was brand new.

* * *

This has been the experience of many companies who have taken advantage of the transformer rewinding service made available by **The A. F. Holden Company**, Detroit metallurgists and producers of heat treating equipment.

* * *

The company's service department points out that when the cost of repair and rewinding are compared to the price of a new transformer, the dollars saved can be considerable.

New Catalog on Phosphor Bronze

A new handbook on phosphor bronze wire, bars, rods, strip, sheets, circles and special shapes has been made available by **Riverside-Alloy Metal Div., H. K. Porter Company, Inc.** The 20-page catalog, devoted completely to phosphor bronze alloys, contains the latest information on Flexograin, a fine grain phosphor bronze, and the Division's facilities for the continuous casting of phosphor bronze strip. Several pages are devoted to the various forms in which phosphor bronze can be produced at Riverside-Alloy.

* * *

The composition, specifications and properties of the various phosphor bronze alloys are given in chart form, especially prepared for readability.

* * *

Copies of the new phosphor bronze handbook are available upon request from: Publications Section, Riverside-Alloy Metal Division, H. K. Porter Company, Inc., Riverside, N. J.

New 25:1 Speed Reducer

An expanded line of shaft-mounted speed reducers announced by **Dodge Manufacturing Corporation,** Mishawaka, Indiana, now includes a new 25:1 double reduction series in eight sizes. The line carries the trade name "Torque-Arm."

* * *

In order to extend the useful-

ness of the line, Dodge engineers have improved the design of the double reduction reducers without changing their overall dimensions or horsepower ratings. Both 15:1 and 25:1 gear ratios are now available in housings of identical dimensions and at the same price. Output speeds range from 12 to 400 rpm.

* * *

A new bulletin, A692, describes the complete line of Dodge shaft mounted speed reducers, including single and double reduction models in 5:1, 15:1 and 25:1 ratios.

Olin Mathieson Offers Aluminum Rod

Cold processed rod and screw machine stock is now available from Olin Aluminum, **Charles S. Barnum Jr.**, manager of Olin Aluminum rod and bar sales, Metals Division, **Olin Mathieson Chemical Corporation,** has announced.

* * *

The new cold processed stock is the product of a special manufacturing method designed to provide exceptionally good density, fine grain structure and close dimentional tolerances. The cold process method is the result of years of research and development efforts.

* * *

An eight-page brochure on these products is available on request. Copies can be obtained by writing to: Metals Division, Olin Mathieson Chemical Corp., 400 Park Ave., New York 22, N. Y.

New NEMA Rerated Motors

The Lima Electric Motor Co., Inc., Lima, Ohio, subsidiary of Consolidated Diesel Electric Corp., has announced a line of dripproof electric motors in new NEMA rerated frame sizes, from ½ HP at 900 RPM through 150 HP at 3600 RPM — frames 182 through 445 URS. They can be furnished either 3 or 2 phase and in all frequencies and commercial voltages below 600 V.

* * *

The company also makes a full line of shaft-mounted speed reduc-

For Fungus Resistance, Specify

TEXTILENE TWI-TAR

Offering great durability along with light weight, Textilene Twi-Tar is successfully used for buried communication cable (bedding and overall serving), expanded ACSR cable (expander between core and conductors), stationary power cable and portable cables.

Twitchell's superior Textilene line also includes: Moisture-resistant fillers — *Twi-Flex* and *Twi-Wax*. Used for non-metallic sheathed cable, maritime shipboard cable, varnished cambric cable.

Soft, dry fillers — *Twi-Port* and *Glascor** (Fiberglas-centered for high tensile strength without added bulk). Used for control, power, appliance, coaxial and communications cables, and all types of portable and flexible cords.

*Patent Applied For

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Twitchell's TEXTILENE Fillers Fill The Bill

Quality-controlled materials that are dependably uniform . . . in standard forms, or customized to special needs.

Initial low cost with savings added by production efficiency . . . flexible, ready-to-use fillers that fit all equipment, handle and form easily, always maintain desired shape.

Assured supply from a reliable domestic source . . . always available in economical and convenient packaging.

Proved performance as components of cables and wires that meet government specifications . . . stability shown by trouble-free installations in continuous service 20 years and longer.

FREE — SAMPLE SPOOLS of any type of Textilene filler to demonstrate the superiority of Twitchell materials in your operation—also technical counsel without cost or obligation. Just tell Twitchell your end-use requirements. *Write, wire, or phone today:*

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The beauty and smooth operation of fireplace curtain screens depend on accurate forming, even spacing, and neat appearance of the mesh. The wire used must be of correct temper, diameter and finish. Uniformity of these properties is of prime importance. Leading fireplace equipment makers choose Continental Wire because it possesses these features dependably, in coil after coil. The ability to take intricate forming is an important reason why Continental Wire is specified for scores and scores of other products made with wire. Continental Curtain Screen wire, 19 gauge through 20 gauge inclusive in size, is available in 500 pound to 650 pound catchweight single length coils packed in Leverpac Drums for faster weaving with less down time, cleaner handling and better storage. For wire in practically any size, finish, temper or analysis, in low or medium low carbon steels, see Continental first!

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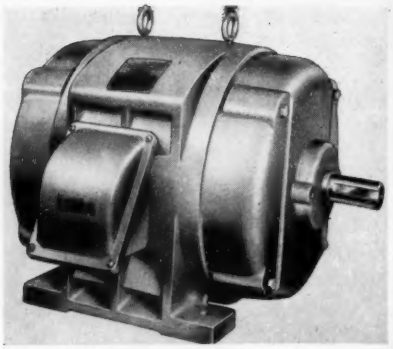


ers from 1 to 40 HP, 10 to 420 RPM.

* * *

For complete information on new rerated Lima Electric Motors and Speed Reducers, write to The Lima Electric Motor Co., Inc., Dept. 437, Lima, Ohio.

Rockbestos Products Becomes Division of Cerro De Pasco

Cerro de Pasco Corporation has reported that one of its United States fabricating subsidiaries, **Rockbestos Products Corporation,** of New Haven, Conn., has been liquidated and its assets conveyed to Cerro de Pasco which also has assumed the liabilities of the former subsidiary. The Rockbestos business henceforth will be conducted as the "Rockbestos Wire & Cable Co. Division of Cerro de Pasco Corporation."

* * *

Robert P. Koenig, Cerro de Pasco president, stated that the changed status and identity of the Rockbestos company is part of a corporate simplification plan intended to bring about various operating economies. In pursuance of this plan Cerro early in July announced the merger into the parent company of another of its fabricating subsidiaries, **The Titan Metal Manufacturing Company,** which thereupon became the Titan Metal Manufacturing Company Division of Cerro de Pasco Corporation.

Company Formed to Sell German Belt Making Machines

A new U.S. and Canada sales and service engineering organization, **The Boltmaster Co.,** 5297

West 130th St., Cleveland 30, Ohio, has been formed to import the Bolt Forming Machines made by Peltzer & Ehler. The new compound is headed by **Howard D. Prutton,** well-known to the American bolt industry.

* * *

The line includes: Automatic Hot Nut Presses, Screw Slotting Machines, Single and Double Blow Cold Headers, complete Boltmakers, Progressive Headers and related machinery. Features are simple and advanced design, ease of set-up, fine craftsmanship and high speed production. Standard and special designs are offered.

* * *

A replacement part warehouse is maintained in Cleveland. The Boltmaster Screw Slotter can be seen in operation by appointment.

New Spring Wire For High Temperatures

A precipitation-hardened superalloy cobalt wire has been introduced by **National-Standard Company** for forming springs to operate at ambient temperatures from 400° to 1400° F. Designated Alloy HS 25 or No. L-605, the spring wire is made principally of these metals: cobalt (46 to 53%), chromium (19 to 21%), tungsten (14 to 16%), nickel (9 to 11%), and carbon (.05 to .15%).

* * *

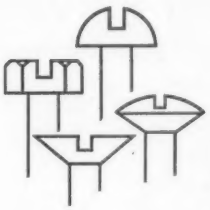
The wire is available annealed to 35% reduction. Wire drawn to 30% reduction, a typical reduction, is available from 0.171- to 0.018-inch diameter. Tensiles for the 30% reduction range from 200,000 to 240,000 psi, depending on wire diameter. Elongation ranges from 4 to 8% for the 30% reduction.

* * *

HS 25 is supplied for automatic coiling with a gray oxide finish that can be removed by nitric acid, tumbling, vapor blasting or similar methods.

* * *

Before drawing, rods are welded together with magnetic stainless steel. Since HS 25 is non-magnetic, welds in finished springs can be identified with a magnet.

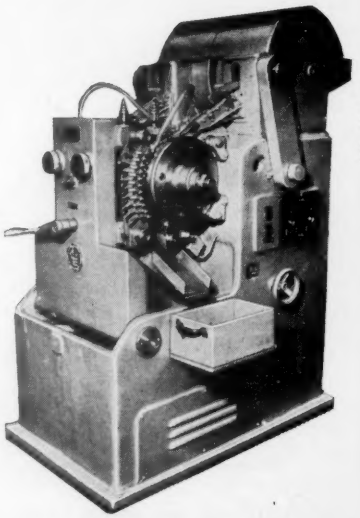


High Output *Low* Tool Cost *SCREW SLOTTING*

★ 1,000,000 PIECES PER TOOL GRIND

★ UP TO 1,000 PIECES PER MIN.

★ FAST SET-UP TIME



Model asm 6 with 2x10 slotting tools shown.

These famous German built machines feature:

- NEW DESIGN—no saw—10 knife blade cutters in steel holder—easily adjustable by simultaneously swinging all cutters to slot depth
- GRINDING FIXTURE—sharpens all 10 cutters at once on a standard surface grinder
- BURR FREE SLOTTING—of any type screw head
- INDIVIDUAL CLAMPING OF EACH SCREW—eliminates tool breakage, gives more accurate slots
- DOUBLE HOPPER AND TWO TRANSPORT DISKS—two different type screws can be slotted simultaneously
- Special design machines available

SOLD AND SERVICED IN U.S. AND CANADA BY

The BOLTMASTER Co.

Exclusive importers of German Craftsman Peltzer & Ehlers Machinery—builders of machinery for the Bolt Industry since 1888

21055 LORAIN ROAD **CLEVELAND 26, OHIO**

Wire Men Who Want **Reel** Service

Call **APCO MOSSBERG** *First!*

Any size, any shape, any time! Apco Mossberg steel reels, spools and bobbins are designed exactly the way you specify, delivered on the day you specify.

Whether it's for drawing, stranding or any other type of processing . . . each Apco unit is custom-made to extremely close tolerances to run true without wire breakage or trapping. Each keeps machine downtime to the minimum . . . gives you a steel-strong, easy-spooling production package that pays off in on-the-line economies.

Tell us your wire or wire handling problems. Apco's engineers, experience, and 50 years of reel service will come up with an answer that makes real sense. Write, wire or phone collect.

PACIFIC COAST REPRESENTATIVE:
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World Trade Center
Ferry Building
San Francisco 11, California

CANADIAN REPRESENTATIVE:
Hugh P. Williams & Co.
47 Colburne Street, West
Toronto, Ontario, Canada

APCO MOSSBERG COMPANY
LAMB STREET, ATTLEBORO, MASSACHUSETTS

Fine Wire Feeder Speeds De-Reeling

Using a servo-controlled tensioning technique the Kinetrol Fine Wire Feeder speeds de-reeling of wire down to 0.0008″ dia. Adjustable tensioning from 0.1 oz. (2½ grm.) to 2½ oz. (70 grm.) enables wire smaller than 50 gage up to as large as 36 gage (.0008″ to .005″) to be accurately controlled and speedily wound.

* * *

Using a novel mechanical arrangement the wire is unwound from the stationary reel by a lightweight rotating arm. Variable tension is provided by a servo controlled jockey pulley and brake system. A special feature of this system is the accurate tensioning that is maintained despite varying winding speeds; this permits winding of irregular formers without breakage or strain.

* * *

Simple and compact, the Feeder provides fast, inexpensive, trouble-free tension control of ultrafine wires.

* * *

Full details from: The Scopes Co., Inc., P.O. Box 56, Monsey, N. Y.

Bulletin on Special Shaped Wire

A four-page technical bulletin on special shaped alloy wire has been revised by **Riverside-Alloy Metal Division, H. K. Porter Company, Inc.** The publication was designed to serve as a handy reference guide, listing properties, advantages and some applications.

* * *

The revised folder has incorporated the latest basic technical data on special shaped alloy wire into an easy-to-read format. Charts show the metallurgical composition of the wire, as well as general limitations. Many of the various special shapes produced at the Alloy Metal Wire Works are graphically presented in the folder.

* * *

Concerned primarily with nickel alloys and stainless steels, the Division's new technical bulletin is available upon request. Copies

may be obtained by writing to: Advertising Department, Riverside-Alloy Metal Division, H. K. Porter Company, Inc., Riverside, New Jersey.

New ASA Standard On Radio & TV Cable

A new American Standard covering dielectric cable of the kind used in radio and television transmitting equipment has been published by the American Standards Association. Its title is American Standard Requirements for Solid Dielectric Transmission Lines, C83.21-1958, and also bears the designation EIA RS-199 as a standard of the Electronics Industries Association.

* * *

The standard refers to solid and semi-solid dielectric transmission lines consisting of:

1. one or more inner conductors,

2. a covering of a layer of flexible low-loss radio-frequency dielectric material,

3. surrounding this a braided outer conductor,

4. the whole covered by a protective sheath and in some cases a braided armor.

American Standard Requirements for Solid Dielectric Transmission Lines, C83.21-1958, is available at $1.20 a copy from the American Standards Association, Dept. PR 92, 70 East 45 Street, New York 17, N.Y.

Catalog On Hand Tachometers

Jones Motrola Corp., 432 Fairfield Ave., Stamford, Conn., has issued a catalog covering its line of Jones Hand Tachometers and their use in speed indication.

* * *

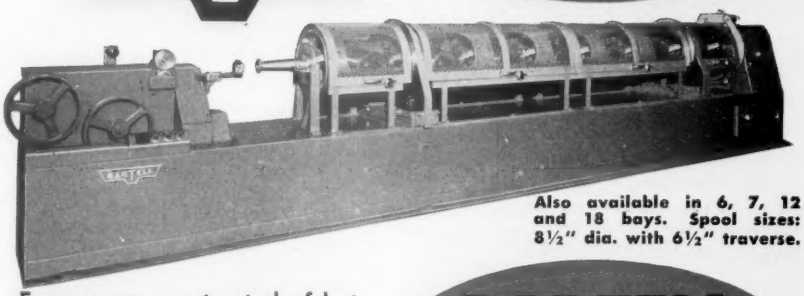
Besides technical data, the catalog contains descriptions, ranges, and prices of five models and information on standard accessories.

* * *

Copies of the catalog are available from the manufacturer without charge or obligation.

Our Advertisers are Reliable Patronize Them

BARTELL FOR THE BEST



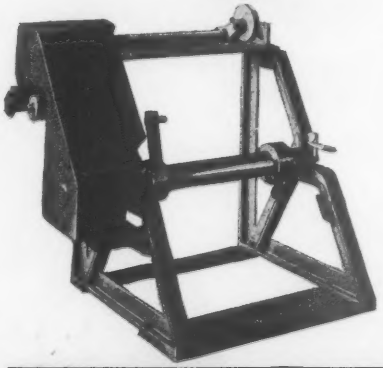
Also available in 6, 7, 12 and 18 bays. Spool sizes: 8½" dia. with 6½" traverse.

BARTELL SEVEN BAY HIGH SPEED STRANDER MODEL 7B-58-15

Frames are constructed of hot rolled shapes and plates to form a rigid box structure. Barrel is extruded 6062T-6 aluminum — Smooth starts through slip clutch driven by 7½ H.P. motor — Operators control station at front of machine — Main power control center at drive end — Electronically controlled automatic stop energizes solenoid operated brakes in event of wire breakage — Spool cradles and associated parts are completely interchangeable from one machine to another — Tungsten carbide wire guides throughout — Lay from ¼ in. to 5 in. long.

• CATERPILLAR CAPSTANS • SINGLE AND MULTIPLE HEAD RE-SPOOLERS • TAKE-UP & PAY-OFF STANDS FOR PLATING EQUIPMENT • WIRE STRANDERS

BARTELL TAKE-UP



This Take-Up is belt-driven, the drive originating from a slip clutch located outside the capstan box. Electrically operated traverse adjustable from zero to maximum reel width. Accommodates reels up to 30" dia. Speed selector sheave adjusts lay on reel to suit diameter of finished strand.

WE ALSO DESIGN AND BUILD SPECIAL EQUIPMENT TO MEET SPECIFIED REQUIREMENTS

BARTELL MACHINE-TOOL CORP.
YACHT CLUB ROAD ROME, N. Y.
• DESIGNERS • MANUFACTURERS • ENGINEERS • CONSULTANTS

Outstanding Personalities of the Wire Industry

Joins Technical Staff of R. H. Miller Co.

The R. H. Miller Co., Inc., Homer, N. Y., manufacturers of "Steelskin" metalworking lubricants, has announced the addition of **Joseph F. Piscitell** to its chemical engineering technical staff.

* * *

Mr. Piscitell, of Syracuse, N. Y., graduated from the Syracuse University College of Engineering in 1957 with degrees of AB in Chemistry and BS in Chemical Engineering. He was formerly employed in the Magnet Wire Plant of Anaconda Wire & Cable Company in Muskegan, Mich., and is familiar with non-ferrous wire drawing.

Lee Wilson Appoints Sales Manager

J. H. Werner was named Sales Manager of **Lee Wilson Engineering Company, Inc.,** Cleveland, Ohio, it was announced by **C. F. Olmstead,** President. Formerly Assistant Sales Manager, Mr. Werner will take over duties previously handled by **J. L. Whitten,** Vice President, who will now devote more of his time to company policy.

* * *

Mr. Werner, a graduate of the Missouri School of Mines and Metallurgy, joined Lee Wilson Engineering Company Inc. in October, 1941, starting as Service Engineer and working his way up through various stages as Production Manager, Sales Engineer, District Manager-Chicago, and, most recently, Assistant Sales Manager.

J. H. Werner

Rome Cable Div. Appointments

Three major management appointments have been announced by **A.D.R. Fraser,** president of the **Rome Cable Division** of Aluminum Company of America.

* * *

Robert L. Williamson, manager of pig and ingot sales for Alcoa since 1955, has been named vice president and general sales manager of the division. He will direct the activities of division product managers and field sales operations from Rome, N. Y.

* * *

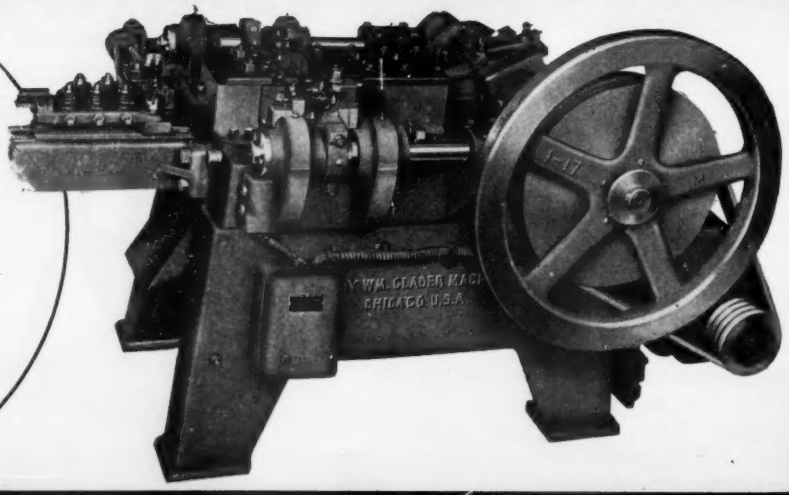
GLADER

HIGH SPEED WIRE NAIL MACHINES

HIGH TONNAGE OUTPUT—LOW MAINTENANCE COST

You can take care of increased production schedules and better product demands with these machines of established reputation.

For 55 years GLADER MACHINES have been giving HIGH QUALITY, LOW COST nail production.



Wm. Glader Machine Works 210 N. Racine Avenue Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

Frederick S. Marks, Sr., treasurer and a member of the board of directors of Rome Cable before it became a division of Alcoa, has been appointed vice president and manager of distribution. **Gerard A. Weiss** has been appointed treasurer of the Rome Cable Division, succeeding Mr. Marks.

Protiva and Scheel Promoted by Heil Process Equipment

E. W. Vereeke, President, **Heil Process Equipment Corp.,** Cleveland, manufacturers of corrosion resistant ventilating equipment, impervious graphite heat exchangers, steam jet agitators, lead anodes and corrosion resistant tanks, announces the appointment of **Richard F. Protiva** to be Manager of Market Development, and **Robert E. Scheel** as Manager of National Branch Sales.

* * *

Mr. Protiva joined Heil as Sales Engineer in 1940 following his graduation from Case Institute of Technology with a degree in Metallurgical Engineering. He became Manager of Process Industry Sales in 1956 and Eastern Sales Manager in 1957.

* * *

Mr. Scheel joined Heil Process Equipment Corp. in 1949 as an

Richard F. Protiva Robert E. Scheel

Estimator following his graduation from Ohio University. He became Sales Engineer in 1953, Chicago District Manager in 1955, and Western District Manager in 1958. He is a member of several technical and engineering societies.

To Handle Division Sales for U.S.I.

Walter J. Kilmer has been made Manager of the Detroit Sales Division for **U. S. Industrial Chemicals Co.,** Division of National Distillers and Chemical Corp. **Alden R. Ludlow, Jr.,** Vice President in Charge of Sales, announced the new appointment. He succeeds **Fred M. Henley,** who is retiring.

* * *

Mr. Kilmer has been associated with U.S.I. for approximately twenty-five years and, prior to his new assignment, was a sales representative for the Company at Buffalo, N. Y.

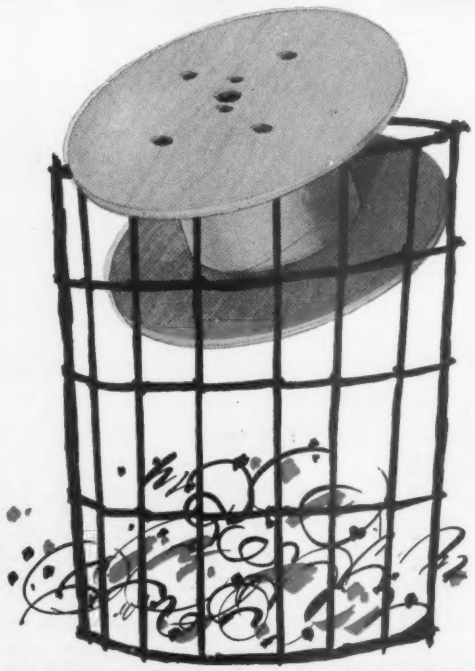
Kaiser Aluminum Announces Promotions

Gillette N. Houck has been named assistant to the manager of the Electrical Conductor Division, **Kaiser Aluminum & Chemical Corp.,** it has been announced by **J. T. Dugall,** division manager. At the same time, Cecil R. Pickens becomes division technical manager at Newark, Ohio.

* * *

Mr. Houck, formerly division manager of promotion and tech-

DISPOSABLE



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UP go your profits when you switch to *Woodcraft* disposable Reels & Spools. The reason: *Woodcraft Reels & Spools cost you less.* Why not *compare* the Woodcraft cost and prove to yourself how many dollars *you* can save.* Available in all sizes, and specifications . . . *without price penalties.*

WOODCRAFT CORP.

501 SALZBURG AVE. • BAY CITY, MICHIGAN

Plywood • Hardboard • Two ply aspen • Two ply pine • Hardboard laminated to Plywood • Drums available in wood, metal, paper or plastic.

* . . . close enough to you to save many, many dollars on shipping costs alone!

nical development, joined Kaiser Aluminum in 1947 and has held a variety of sales and management positions in Kansas City, Chicago and Newark, Ohio. His promotion moves him from the company's aluminum wire and cable works at Newark, Ohio, to division headquarters in Oakland.

* * *

Mr. Pickens will have responsibility for co-ordinating and directing the engineering and technical development programs, reporting to Mr. Houck. He joined Kaiser Aluminum in 1957 when the firm acquired the Wire and Cable Department of U.S. Rubber Co., where he had been associated for eleven years.

Lee Wilson Forms Chemical Division

The formation of a Chemical Division to be headed up by **Frank C. Haas,** former vice president and director of the Archer-Daniels-Midland Company, was announced today by **Lee Wilson,** Chairman of the Board of the **Lee Wilson Engineering Company, Inc.,** Cleveland.

* * *

The new division was formed to engineer and develop specific chemical processes for the metal producing and metal fabricating industries, according to Mr. Wilson.

* * *

Mr. Haas joined Archer-Daniels-Midland in 1929 as chemical director of their Wyandotte, Michigan plant. Following several promotions he was elected vice president in 1950 and a director in 1954. He studied chemical engineering at Columbia University.

Frank C. Haas

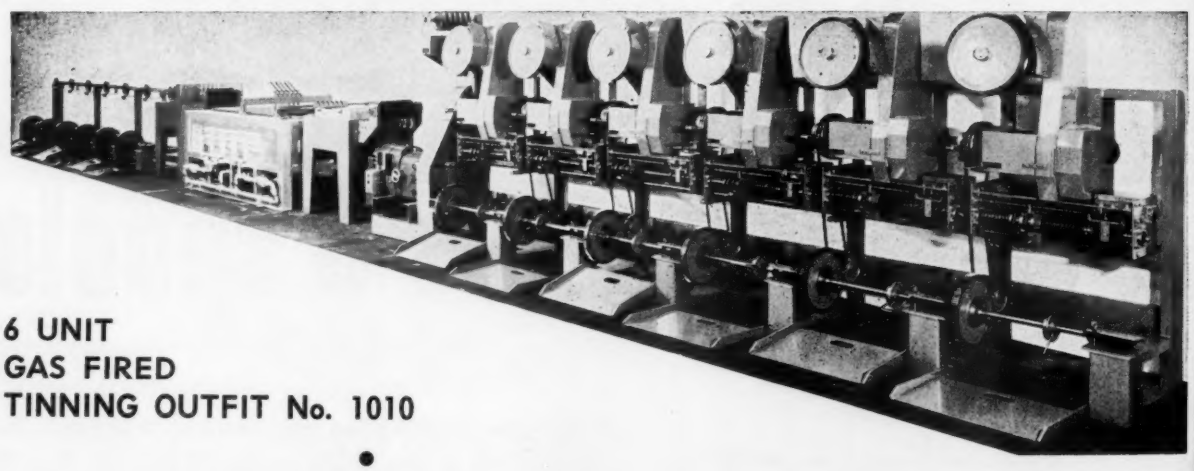
* * *

Riverside-Alloy Appoints Assistant Works Manager

Roland H. Wilson has been appointed Assistant Works Manager of **Riverside Metal Works,** Riverside-Alloy Metal Div., H. K. Porter Co. In his new assignment, Wilson will maintain production schedules, supervise facilities and restudy quality control procedures.

* * *

Mr. Wilson, who joined Riverside-Alloy in 1949, has been coordinator for modernization programs at Riverside ever since Porter acquired the plant. He was appointed Administrative Assistant in 1957. Prior to that, he held several positions in the Standards Department, including Standards Supervisor. He graduated from the University of Pennsylvania in 1949 with a B.S. degree in Mechanical Engineering.



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GAS FIRED
TINNING OUTFIT No. 1010

Send for information on the following:

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MULTIPLE or SINGLE UNIT WIRE TAKE-UPS
FINE WIRE DRAWING MACHINES
MAGNET WIRE ENAMELING EQUIPMENT, INCLUDING
PRE-ANNEALERS, SYNTHETIC ENAMEL APPLICATORS and CIRCULATING SYSTEMS
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"American" INSULATING MACHINERY COMPANY
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CF&I Appoints New York District Sales Manager

Kingdon B. Dietz has been appointed New York District Sales Manager of **The Colorado Fuel and Iron Corporation, L. A. Watts,** General Manager of Sales, Eastern Division of The Colorado Fuel and Iron Corporation, has announced.

* * *

Mr. Dietz had been Assistant Sales Manager since January 1958. He joined CF&I in July, 1954, as a New York District Salesman, and spent the next three and a half years representing a wide range of CF&I products throughout New York and New Jersey.

Warren Wire Appoints Managers

Warren Wire Company, Pownal, Vermont, manufacturers of magnet wire, aircraft cable, bare and tinned copper wire, and Teflon coated glass fabric, yarn and cordage, has appointed **David B. Barr** as Midwestern Sales Manager. The company maintains warehouse facilities for stock items at the Kelmer Terminal Warehouses, 2237 So. La Salle St., Chicago, Ill.

* * *

At the same time it announced the appointment of **Keith M. Seegmiller** as Sales Manager of its Western Division, which has manufacturing and warehouse facilities at 1601 Chestnut St., Alhambra, Calif.

* * *

The company manufactures bare and tinned copper wire, magnet wire, including Teflon covered types, high temperature lead wire, aircraft cable and Teflon-coated glass fabric, yarn and cordage.

To Direct Southern Electrical's Sales

William J. Hagan III, has been appointed director of electrical conductor sales of **Southern Electrical Company,** Chattanooga, an operation of the Metals Division of Olin Mathieson Chemical Corporation, **Derek Richardson,** vice president of aluminum sales, Metals Division, has announced.

* * *

Formerly assistant director of electrical conductor sales, he succeeds H. H. Bullen who will continue his association with the company as a consultant.

* * *

Mr. Hagan will report to Mr. Richardson. He has been associated with Southern Electrical Company since its founding in June, 1946.

* * *

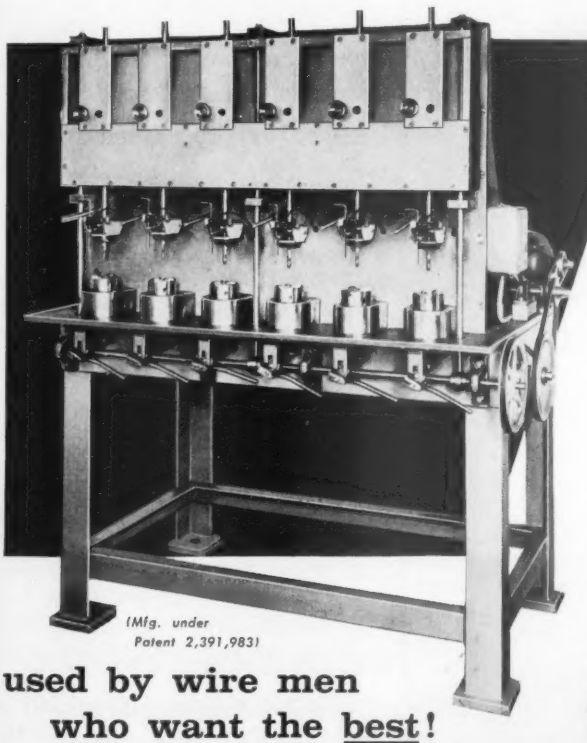
Other appointments announced by Mr. Richardson are **L. W. Carpenter,** manager of field sales, and **G. E. Thurman,** manager of sales promotion, who will report to Mr. Hagan.

Reynolds Appoints Industrial Engineer

Appointment of **Cecil W. Guyatt** of Pittsburgh, Pa., as chief industrial engineer of **Reynolds Metals Company** was announced by **W. Monroe Wells,** vice president of operations.

* * *

Hired in 1935 by U. S. Steel as its first district industrial engineer, Mr. Guyatt set up the department



used by wire men
who want the best!

Sjogren
AUTOMATIC
DIE SIZERS

Another SJOGREN-BUILT Machine for "wire men who want the best!"

This Automatic Die Sizing Machine is available in 2 models — the Six Spindle (as shown) and the Single Spindle unit. Both models are identical in construction and the same production per spindle applies. Typical production per spindle, per hour, on the six spindle machine is:

2 dies at .165"	8 dies at .082"
4 dies at .135"	10 dies at .072"
6 dies at .095"	15 dies at .062"

(Total of 45 dies or more, per hour)

Sjogren engineers cordially invite wire men who are interested, to make a visit. If desired, a test run will be arranged, using their own dies, pins and compound.

Sjogren TOOL & MACHINE CO., INC.
14 Sword St.
AUBURN, MASS.

WIRE PULLERS • WEDGE GRIPS • JAWS FOR ALL MAKES OF PULLERS AND TESTING MACHINES • GAGE ROLLERS • SWAGING HAMMERS • POINTING DIES • WIRE SPOOLERS

in the Worcester, Mass. district of the **American Steel & Wire Division.** From 1939 to 1941 he was assistant superintendent of the Worcester plant. In the next four years he was first assistant and then chief industrial engineer of the Division.

* * *

In 1945 he moved to Pittsburgh as assistant to the chairman of operating committees of U. S. Steel. When industrial engineering was organized throughout the corporation in 1948, he was made a division chief industrial engineer. In 1951 he became chief industrial engineer — methods. He is a graduate of Lehigh University with an electrical engineering degree.

Carpenter Steel Appointment

The Carpenter Steel Co., Reading, Pa., has named **Fenton R. Mitchell, Jr.,** assistant branch manager of the New York and Bridgeport warehouses. He will assist the district manager in operation of these branches.

* * *

A member of the American Society for Metals, he joined Carpenter in 1951 as an inside salesman. In 1953 he became a sales representative in the Hartford territory and in 1955, sales representative in the Bridgeport territory.

Blane Appoints Midwest Representative

The W. F. E. Bomke Sales Co., Chicago, has been appointed Sales Representative in the Midwest, according to an announcement by **Gerry Kerstein,** Vice President and Sales Manager of **The Blane Corp.,** Canton, Mass., manufacturers of vinyl compounds and vinyl color concentrates for the wire and cable industry.

* * *

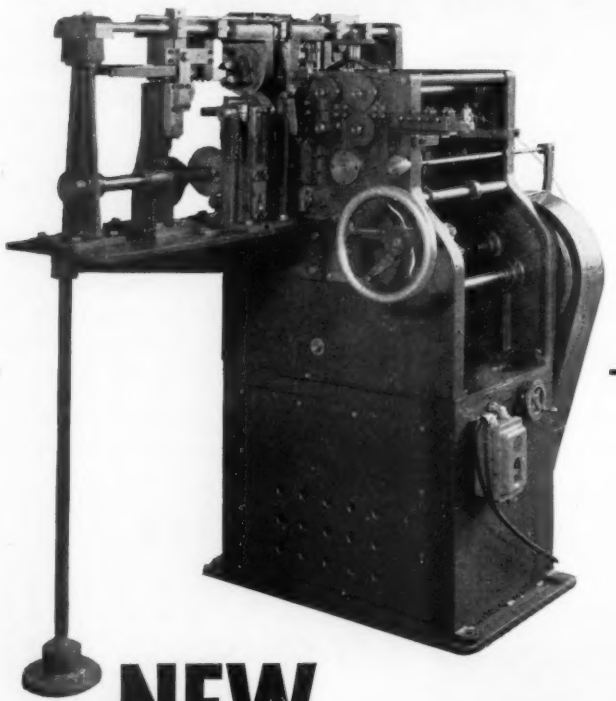
General Partners in the Bomke Company are **J. D. Parsons** and **Donald R. Brooks.** Mr. Parsons, a business college graduate, has been associated with Bomke for his entire career, recently completing his 25th anniversary with the company. Mr. Brooks, a graduate of Chillicothe Business College, was associated with **Popular Mechanics Magazine** for 16 years prior to joining Bomke.

* * *

The W. F. E. Bomke Sales Co. will cover the territory of Illinois, Iowa, Indiana, Wisconsin, Michigan, Ohio and Kentucky for Blane.

RB&W Changes

Lambert M. Kaspers has been named to the new post of plant manager and assistant to the general manager of the Port Chester, N. Y., plant of **Russell, Burdsall & Ward Bolt & Nut Co.** He was plant manager at the Rock Falls, Ill., plant, where he has been succeeded by **George J. Nieman** who has headed the cost, payroll, and industrial engineering departments there since 1952. In addition, **Ronald M. Bowman** has been appointed assistant manager at Rock Falls, a new position.



NEW For Springmakers

AUTOMATIC COILER and LOOPER

WELLS' NEW FULLY AUTOMATIC SPRING COILING AND LOOPING MACHINE coils, trims and loops in sequence. By trimming before looping extremely accurate springs are made. Produces cross-over, machine and side loops, or any combination of these.

Machine shown above handles .025" to .062" diameter wire, forming coils of 3/16" o.d. to 5/8" o.d., 1/2" to 5" long.

Loops on each end can be varied 360° to each other and held to ±3°. Loop openings can be held to ±.010", or less.

Adapted from the WELLS large diameter automatic coiling and looping machines made for several years, this new spring machine will be a boom to manufacturers of mechanical coil springs.

Made By The Producers of the Wells Straightening And Cutting Machines.

Write for information

Frank L. Wells Company

BUILDERS OF FINE WIREWORKING MACHINERY

5821 FIFTH AVENUE • KENOSHA, WISCONSIN

QR — HARVEY SPRING MFG. CO. — 671 N. Sangamon St., Chicago, Ill.

Heads Crucible's Spring Division

William R. Mogg has been appointed general manager of **Crucible Steel Company's** spring division and will be responsible for all phases of the division's operations including production, sales, personnel, and administration. He succeeds **T. T. Crowley,** who has been named vice president and general manager of Crucible Steel of Canada, Ltd.

Leib Advanced by Copperweld

James M. Darbaker, president of **Copperweld Steel Company,** has announced the promotion of **F. E. Leib** to vice president in charge of the wire and cable division, Glassport, Pa.

Firth Sterling Promotes Two

Firth Sterling Inc. announces the promotion of **M. L. (Pete) Backstrom** to sales development engineer and **A. G. (Jerry) Weiland** to Chicago district manager, carbide division.

* * *

Mr. Backstrom joined Firth Sterling eleven years ago and has served in the carbide division as chief carbide sales engineer, assistant sales manager, carbide division, and carbide district manager in Chicago. In his new capacity, Mr. Backstrom will be responsible for the sales of heavy metal, forgeable tungsten and percussion tips, will assist district sales on technical problems and the development of new applications for cutting and die materials.

* * *

Mr. Weiland started with the company nine years ago in the accounting department, and later served as carbide cost analyst and sales analyst. He served as carbide sales office manager before being transferred to the mid-east district as salesman.

Sylvania Appointments at Warren

J. Marshall Smith has been appointed manager of the metal base plant of **Sylvania Electric Products Inc.,** Warren, Pa., subsidiary of General Telephone & Electronics Corp. He had been manufacturing superintendent at Sylvania's fluorescent plant at Danvers, Mass. He replaces **R. H. Alexander,** named engineering manager for the division's metal base operations.

Made V.P. of J & L Division

John T. Bachman, has been appointed a Vice President of **Jones & Laughlin Steel Corporation's** Stainless and Strip Division in Detroit, it was announced by **M. K. Schnurr,** President of the Division. Mr. Bachman formerly was General Manager — Strip Operations.

* * *

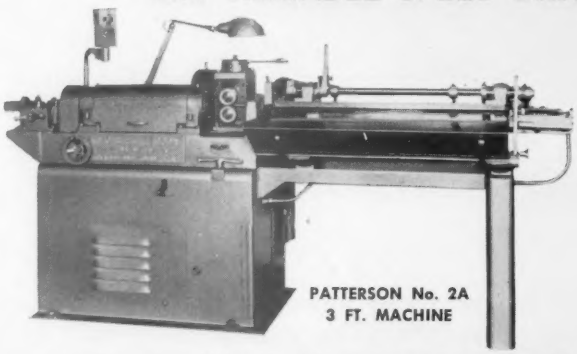
He will be in charge of carbon and stainless strip sales; Kenilworth (N. J.) and Los Angeles Warehouse sales; and sales activities of the Metallon Plant in Canfield, Ohio.

* * *

Mr. Bachman's career in the steel industry began in 1923 with U. S. Steel. He has subsequently been associated with Sharon Steel and Cold Metal Products. He was appointed Vice President and General Manager of Sales when the latter company became the J&L Strip Division in 1957, and was named General Manager — Strip Operations when the J&L Strip Steel and Stainless Steel Divisions

GEO. C. PATTERSON
HI-SPEED
AUTOMATIC WIRE STRAIGHTENING & CUT-OFF MACHINES

ELECTRICALLY OPERATED
with VARIABLE SPEED DRIVE



PATTERSON No. 2A
3 FT. MACHINE

We are proud to present this machine & 35 additional models to the mills and fabricators of wire, for we honestly believe they are top value in their field today. We have spared no expense to give you a precision machine tool that will give years of uninterrupted service. All iron castings are close grained Meehanite iron; cut-off and opener levers are high grade steel castings; all guides are hardened tool steel; electrical equipment is wired ready to run.

- MINIMUM COST
- MAXIMUM PRODUCTION
- ACCURATE LENGTHS
- NEW FEATURES

WRITE FOR FREE LITERATURE ON YOUR REQUIREMENTS

The GEO. C. PATTERSON Machine Company

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PHONE: BRoadway 1-1808

were joined in 1958 to form the J&L Stainless and Strip Divisions.

United Wire & Supply Appointment

Edward J. D'Amore has been appointed Service Sales Manager of the Brazing and Wire Division of the **United Wire & Supply Corp.**, Providence 7, R. I., J. G. Landrigan, General Sales Manager, has announced.

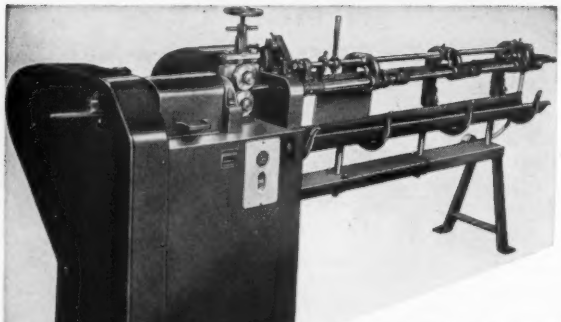
* * *

Mr. D'Amore has been associated with United since 1948 serving in the mill, the laboratory and, most recently, in the sales department. He has studied Engineering and Metallurgy at the University of Rhode Island.

Indian Cable Men Visit the U.S.

K. Aggarwal, Managing Director, and **N. R. Lodh,** Works Manager, of the **Devidayal Cable Industries (Pvt.) Ltd.,** Bombay, India, recently visited this country, during which they purchased substantial quantities of the latest types of American machines for the manufacture of insulated wire and cable and enameled wires.

New! Improved! Fast!
WELLS STRAIGHTENER & CUTTER



S & C machines for small diam. wires Speed: Approx. 115 F.P.M.

This completely redesigned line combines maximum efficiency with that rugged dependability, for which WELLS S&C machines have become justly famous.

Built in several sizes to handle 2 to 18 ga. basic and high carbon wire.

FEATURES

The guide bar of these new machines can be supplied for any cut lengths • The rotary flier runs on ball bearings for smoothness and long life • Cut-off is actuated by a solenoid for extreme accuracy of cut lengths • A two point cam construction provides a quick and positive return of the cut-off knife, eliminating the need for a clutch and dog • A counter is standard equipment.

A COMPLETE RANGE OF S & C MACHINES IS MADE BY WELLS FOR ALL SIZES OF WIRE. SEND FOR CATALOG ON THE COMPLETE LINE.

Frank L. Wells Company

Builders of Fine Wire Working Machinery

5821 FIFTH AVENUE • KENOSHA, WISCONSIN

Roebling Appointments

The John A. Roebling's Sons Div., CF & I, Trenton 2, N. J., has announced the appointment of **Robert M. Lamborn** as Manufacturing Manager, Cold Rolled Steel Products Div., and of **R. Garrett Boetsma** as Manager of the Industrial Engineering and Planning Department.

R. H. Miller Elects Officers

At the annual Board of Directors meeting held recently at the **R. H. Miller Co., Inc.,** Homer, New York, the following were elected to office in the Company:

* * *

Randolph V. Miller, President and Treasurer, **Walter A. Smigel,** Executive Vice President and **Adeline Miller Colton,** Vice President and Secretary.

* * *

The R. H. Miller Co., Inc. currently is celebrating its 50th year in the development and manufacture of "Steelskin" Metal Working Lubricants.

Erwin Loewy

Erwin Loewy, founder and head of **Loewy-Hydropress** and a Vice President of its parent company, **Baldwin-Lima-Hamilton Corp.** died on July 13, 1959

* * *

Mr. Loewy had had a long and distinguished career in designing and building hydraulic presses and rolling mills, many of which are in use in the wire industry. Several years ago he entered the field of rocket and missile launching equipment and built the famous ship motion simulator for the Polaris, launching installations for the International Geographical Year, and shipboard handling and stowage systems for the Defense Missile Program.

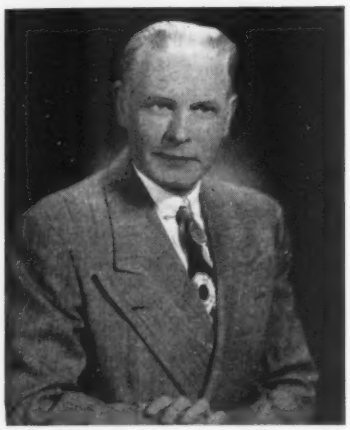
John Gerald McGreevy

John G. McGreevy, Vice President of the **Apco Mossberg Company,** Attleboro, Massachusetts, died suddenly at his home on the

morning of August 26, 1959.

* * *

Mr. McGreevy, or "Jerry", as he was affectionately known by his host of friends, was a graduate of the La Salle Academy in Providence, R. I. He started with Apco Mossberg in 1924 and for the last twenty years had been Vice President of the company, which was



John G. McGreevy

closely associated with the wire industry through the manufacture of spools and reels.

* * *

Jerry had been an active member of The Wire Association for twenty years and was widely known and liked for his genial personality and outstanding abilities. Up to the day of his passing he had been active in business.

Richard L. Wilcox

Funeral services were held in Waterbury on August 14 for **Richard L. Wilcox,** retired chairman of the **Waterbury Farrel Foundry & Machine Company,** who died on August 12 at Bridgeport Hospital after a short illness.

* * *

Mr. Wilcox, who became chief engineer in the coldheading machine division of the company where he served 57 years, was an internationally known specialist in his field.

* * *

He started his career as a self-educated draftsman. He was president of the company on the occasion of its 100th anniversary in 1951 and assisted workers in demonstrating various machines for the benefit of visitors at the time of the celebration. He was elected president in 1947 and chairman in 1954. He retired in March, 1955.

Albert C. Nehring

The Nehring Electrical Works of De Kalb, Illinois, has announced with deep sorrow the death on July 7, 1959, of **Albert C. Nehring,** former Secretary-Treasurer, Director and Manager of plants of the company.

* * *

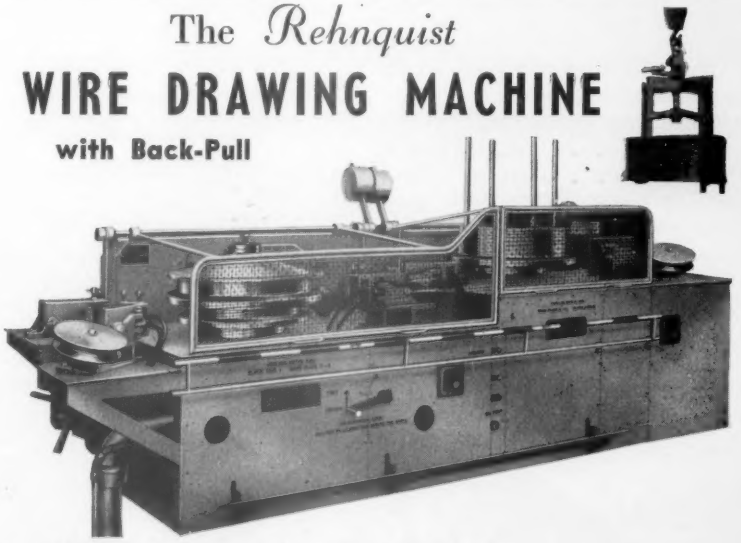
Mr. Nehring, with his three brothers, started to work in the electric wire and cable industry in 1901, and was well and widely known throughout the industry.

Our Advertisers are Reliable
Patronize Them

The *Rehnquist*

WIRE DRAWING MACHINE

with Back-Pull



A NEW CONCEPT OF EFFICIENCY

Counterdrawing, or back-pull, increases die life and consumes less power.

While good for any wire, these machines are especially efficient in drawing Stainless, High Carbon and Resistance Wires.

A single motor drives the machine, different blocks being connected by gears operating through differential gears. Important feature of the differential is the automatic adjustment of all blocks to each other to maintain tensions without slippage. Wire runs from block to block with no accumulation or twisting.

All dies and blocks water cooled. Pneumatic controls stop the machine if reel trouble develops. Full safety features to highest standards built in. Construction is heavy for long service. Finishing block supplied in diameters required for your operations. Machine occupies floor space of 12′ by 9′ overall. Motor is 85 hp, 2-speed AC, 865/1730 rpm. 4-speed gear box gives 8 different speeds of from 108 to 1380 fpm.

Get the facts on these remarkable machines.

Write or Telephone

General Agent for Canada and U.S.A.:

ATLAS POLAR COMPANY LIMITED

POST OFFICE BOX 160 **TORONTO 16, CANADA**

Tel.: Plymouth 7-3641

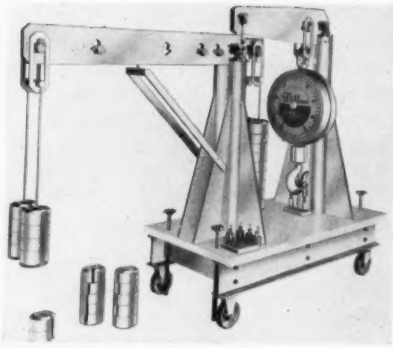
New Calibrating Machine Provides Increased Accuracy

To meet Bureau of Standards and Weights and Measures accuracy requirements for weighing scales, engineers at the **W. C. Dillon Company** have developed a unique calibrating machine. The device was originally designed for setting the gradations of dynamometers and other Dillon precision instruments to exacting specifications. Because of the interest shown in its unusual accuracy, the machine is now, however, being offered as a custom-built end-product to other manufacturers.

* * *

Finely engineered knife-blade leverage machines are among the most accurate measuring devices known to science. Allowing for infinitesmal friction at pivot points, this apparatus gives indications that are 99.8% accurate, whether weighing 20,000 pounds or a few ounces.

* * *



Inquiries are invited for standard as well as special versions of this new calibrator-testing machine. Write W. C. Dillon & Company, Inc., 14620 Keswick Street, Van Nuys, California.

Morgardshammars Opens American Office

Due to the growing interest in the "Beeline" Wire Drawing Machines in this country, the manufacturer, **Morgardshammars Mekaniska Verkstads A. B.**, Morgardshammar, Sweden, recently established an American affiliate to give customers better service and to warehouse stocks of parts.

* * *

This firm, **MH. Machines,** located at 19002 Lomond Blvd., Cleveland 22, Ohio, is operated under the direction of Mr. Yngve B. Bengston. The parent company, which in addition to manufacturing the well-known Beeline types of straight-through wire drawing equipment, also makes rolling mills and mining machines. Founded in 1856, the company is now in its 113th year of existence.

* * *

Through the new arrangement the company is able to offer relatively prompt deliveries and to render service and advice from its centrally located office in Cleveland.

Get the habit of reading regularly
WIRE AND WIRE PRODUCTS
The Wire Man's Magazine

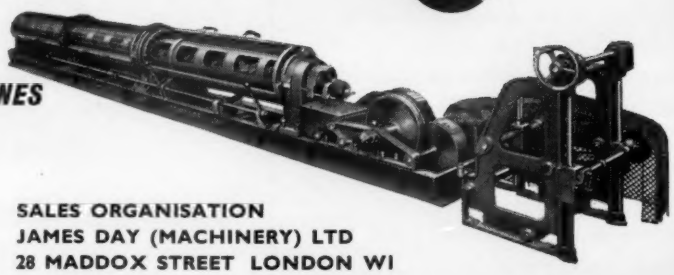
world wide sales...

U.S.A. NORWAY SWEDEN AUSTRALIA SCOTLAND FRANCE NORTHERN IRELAND RHODESIA INDIA ENGLAND AUSTRIA CANADA SOUTH AFRICA MALAYA WALES EIRE BELGIUM ITALY CZECHO SLOVAKIA

. . . indicate a world-wide reputation. Hanson & Edwards have supplied High Speed Tubular Stranding Machines to many of the most important Wire Rope and Cable factories throughout the world. These machines have rotors which run in large SPLIT ROLLER BEARINGS, not on support rollers, giving higher speeds, smoother running and lower maintenance costs

ROLLER BEARING TYPE
HIGH SPEED TUBULAR
STRANDING MACHINES

Made in various sizes for reels from 5"x 2½" up to 24"x 12" Write now for details



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P2035

A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.

Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,901,789, POCKET GROUND SCREW, patented September 1, 1959 by Harry S. Frank, Bellerose, N.Y.

The screw comprises a single length of heavy round wire spirally wound about the conical end of a post adapted for insertion in the ground, with the wire spiral intended to facilitate insertion by a screwing motion of the post.

* * *

No. 2,901,966, AUTOMATIC BINDING OF COILS OF WIRE, patented September 1, 1959 by Hermann Bocher, Koln-Kalk, Germany.

The binder is intended to wrap wire around three sides of the sections of a coil of wire, compress the coil, and then twist the ends of the wire.

* * *

No. 2,902,060, CUTTING AND TWISTING DEVICE FOR COILED WIRE, patented September 1, 1959 by William O. Sprang, Detroit, Mich., assignor to No-Sag Spring Company, Warren Township, Macomb County, Mich., a corporation of Michigan.

More specifically, the mechanism is for severing the ends of a pigtail after it has joined the end coils of two adjacent rows of springs, and bending the severed ends in a manner to prevent the pigtail from moving lengthwise to the springs.

* * *

No. 2,902,079, SPRING COILING MACHINE WITH MEANS FOR SEPARATING FEED ROLLS DURING CUTTING CYCLE, patented September 1, 1959 by Alfred H.Costello, East Williston, and Edward M. Costello, Westbury, N.Y., assignors to The Torrington Manufacturing Company, Torrington, Conn., a corporation of Connecticut.

A cylindrically-operable spring making machine is disclosed and related to the machines described in patent 2,119,002 and Reissue 24,345 of August 20, 1957.

* * *

No. 2,902,535, PREFOLDED CORD AND METHOD OF MAKING SAME, patented September 1, 1959 by Wallace R. Francis, Milford, Conn., assignor to General Electric Company, a corporation of New York.

This invention relates to a two-wire conductor cord of non-circular shape, the cord being folded sharply in opposite directions, the insulation at their folded portions being set into folded shape to facilitate the hanking of the cord into a neat bundle.

* * *

No. 2,902,797, WIRE STRIPPING APPARATUS, patented September 8, 1959 by Louis M. Carpenter, Fayetteville, N.Y.

There are seventeen claims to this patent in which fibre glass wheels are the sole abrasive elements for stripping the ends of wire.

* * *

No. 2,902,886, MULTIPLE-WIRE DRAWING MACHINE TRANSMISSION, patented September 8, 1959 by Johanna Nacken, Nuremberg, Germany.

A transmission for a continuous wire drawing machine in which the wire to be drawn is guided over a series of rotary drawing blocks, each attenuating the wire by a predetermined percentage, is disclosed, the machine being of the slipless type, and the transmission is said to permit continuous operation of the machine without requiring intermittent stopping of the filled blocks.

* * *

No. 2,903,384, METHOD OF PREPARING STAINLESS-STEEL WIRE FOR DRAWING AND FORMING, patented September 8, 1959 by Joseph C. Grass and Anton C. Zupansic, Waukegan, Ill., assignors to United States Steel Corporation, a corporation of New Jersey.

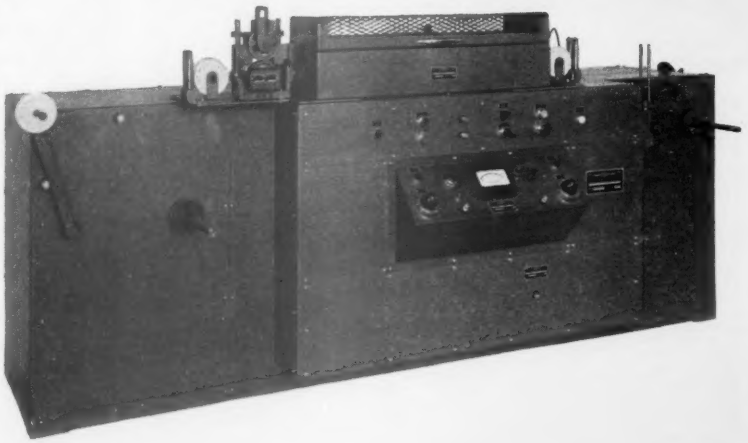
Another Boost for Your Wire Manufacturing Output...

THE NEW ENJACO "3 IN 1" INTEGRAL RE-SPOOLER, Class H

This new equipment incorporates Re-Spooling, Measuring and Spark Testing in one compact unit . . . saving space . . . reducing handling . . . speeding production.

The unit shown accommodates spools or reels up to 12" O.D. on takeup and 18" O.D. on pay-off, wire diameters up to 3/16", and wire speeds up to 800 f.p.m. Spark Testers are available in either A.C. or D.C.

ASK FOR CATALOG SECTION 2D-4



ENJACO CORPORATION

JAMES L. ENTWISTLE, President

100 GLEN ROAD, CRANSTON 10, R. I., U.S.A.

MAIL, P.O. BOX 3674 • PHONE HOPKINS 7-8411

CABLE "JALENCO" PROVIDENCE

The method consists in immersing the wire for from 20 to 60 minutes in a dilute sulphuric-acid bath at a temperature beween 130 and 185°F. containing an activating addition of between .35 and .5% sodium thiosulphate, then immersing the wire in a water suspension of lime and baking it for several hours at a temperature between 800 and 1000°F., in an oxidizing atmosphere, thereby forming, it is claimed, on the wire a tough, adherent flexible coating composed at least in part of lime, metallic sulphide and hydrous ferric oxide.

* * *

No. 2,903,403, METHOD OF COPPER-PLATING METAL SURFACES, patented September 8, 1959 by Wennemar Strauss, Dusseldorf-Benrath, Germany, assignor to Dehydag, Deutsche Hydrierwerke G.m.b.H., Dysseldorf, Germany, a corporation of Germany.

Iron surfaces may be copper plated by pickling the objects in an acid pickling bath containing an inhibitor compound having an inhibiting effect of at least 50% and thereafter applying the final copper plate directly to the pickled surface of the objects to which a quantity of pickling bath solution remains adherent by electroplating the objects in an acid solution of a copper salt.

* * *

No. 2,903,720, METHOD AND APPARATUS FOR CUTTING DOUBLE ENDED NAILS FROM WIRE STOCK, patented September 15,, 1959 by Cyril Harry James, Leicester, England, assignor to United Shoe Machinery Corporation, Flemington, N.J., a corporation of New Jersey.

The machine is described as an improvement upon that of the same inventor disclosed in patent 2,295,662, dated September 15, 1942. Five machine and one method claim.

* * *

No. 2,903,967, WIRE MESH SCREEN, patented September 15, 1959 by Herbert S. Levin, Huntington, New York, assignor to Colonial Process Supply Co., New York, New York, a partnership.

A wire mesh screen construction is disclosed, including a floating bar for contacting the outer side of vertical frame flanges and a locking bar, whereby a wire mesh covering the frame may pass around the bottom flange of the floating bar and around the flange of the lock bar.

* * *

No. 2,904,269, COIL WINDING APPARATUS, patented September 15, 1959 by Robert J. Eminger, Kendallville, Ind., assignor to Fort Wayne Tool, Die & Engineering Company, Fort Wayne, Ind., a company of Indiana.

More specifically, the appartus is for automatically and sequentially winding multi-pole stators in alternating directions on adjacent poles.

* * *

No. 2,904,270, CLAMPING MECHANISM FOR STATOR WINDING APPARATUS, patented September 15, 1959 by Richard G. Nill, Fort Wayne, Ind., assignor to Fort Wayne Tool, Die & Engineering Company, Fort Wayne, Ind., a company of Indiana.

Among the objects of the invention are to properly locate the stator in relation to the fixed path of movement of the winding wire for obtaining proper winding action, and to reduce winding time between winding cycles.

* * *

No. 2,904,803, MECHANISM FOR REMOVING WIRE COATING, patented September 22, 1959 by Stanley J. Gartner, Emporium, Pa., assignor, by mesne assignments, to Sylvania Electric Products, Inc., Wilmington, Del., a corporation of Delaware.

Insulation is removed from wires by a vibrating breaker contacting the insulation, and the removed insulation is brushed away by a brush operating in the intervals between contact of the insulation by the breakers.

* * *

No. 2,905,078, APPARATUS FOR HANDLING COILS, patented September 22, 1959 by Edward A. Laine, Leechburg, Pa., assignor to Allegheny Ludlum Steel Corporation, Brackenridge, Pa., a corporation of Pennsylvania.

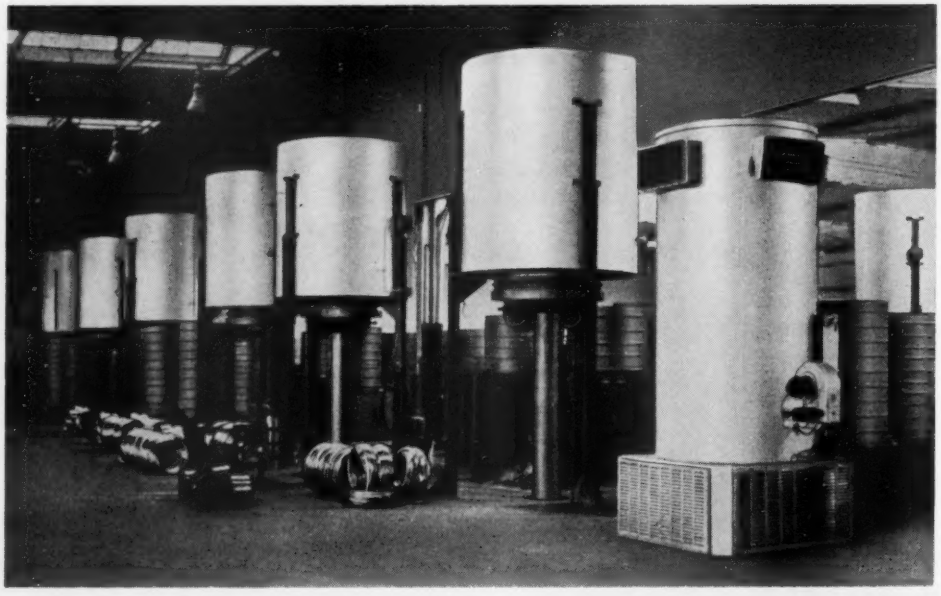
More specifically, the apparatus is for effecting the handling of a wound coil disposed horizontally on a roller conveyor for lengthwise movement thereof in a predetermined plane of movement.

* * *

No. 2,905,400, WIRE CONNECTING MACHINE, patented September 22, 1959 by Rudolph F. Mallina, Hastings on Hudson, N.Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York.

More specifically, the machine is adapted for controlling machinery for connecting wires between terminals of

THE LAST WORD IN MODERN EFFICIENT DESIGN!



SEVERAL VACUUM BRIGHT ANNEALING UNITS WHICH WE HAVE INSTALLED IN ONE OF THE MOST PROMINENT CABLE WORKS IN GERMANY

(German and Foreign Patents)

*

SOLE REPRESENTATIVE:
PAUL REICHER
Machinery & Equipment
600 Eglington Ave., East,
Toronto 12, Ont., Canada

OFENBAU **FRITZ** G. m. b. H. & Co. K. G. **HAGEN,** (W.-GERMANY)

a mounted array of electrical apparatus units.

* * *

No. 2,905,401, WINDING APPARATUS, patented September 22, 1959 by Howard H. Ewald, Los Angeles, Calif., assignor to Hughes Aircraft Company, Culver City, Calif., a corporation of Delaware.

The apparatus is adapted for winding electrical potentiometers and the like. Accurate control of the pitch and spacing between adjacent windings is said to be assured.

* * *

No. 2,905,406, COIL UNREELER, patented September 22, 1959, by Kjell A. Falck-Pedersen, Cicero, Ill., assignor to Acme Steel Company, Chicago, Ill., a corporation of Illinois.

Steel strapping and the like may be withdrawn from a coil thereof while a quantity of the material is held in a slack condition and may be withdrawn without overcoming the inerta of the coil.

* * *

No. 2,905,409, WIRE DISPENSING DEVICE, patented September 22, 1959 by Allen C. Sheldon, Fort Wayne, Ind., assignor to Rea Magnet Wire Company, Incorporated, Fort Wayne, Ind.

The principal feature of the invention resides in a wire retarding base in the form of an inverted cone having damping walls extending upwardly and outwardly, to dampen the elliptical action which is set up in rapidly withdrawing the wire from the wire drum.

* * *

No. 2,405,502, CARRIER FOR CARTONS, patented September 22, 1959 by Edgar F. Brown, Bennington, Vt.

The carrier is constructed wholly of wire and is adapted for carrying milk cartons.

* * *

No. 2,906,299, MANUFACTURING GRIDS, patented September 29, 1959 by Arthur Alan Brooke, Toronto, Ontario, Canada, assignor to Canadian General Electric Company, Limited, Toronto, Ontario, Canada, a corporation of Canada.

A grid-forming machine is disclosed for work upon a strip of grid wire normally including a pair of laterally spaced elongated wire supports about which the wire is wound with a substantial part of the supports being contained within the space defined by the wire.

New Tentatives Approved by ASTM

Copper and Copper Alloys (Approved April 24, 1959)

Specifications for:

Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines (ASTM B 16-58; ASA H8. 1-1959)

Leaded Red Brass (Hardware Bronze) Rod, Bar, and Shapes (ASTM B 140-58; ASA H33. 1-1959)

Seamless Copper Pipe, Standard Sizes (ASTM B 42-58; ASA H26. 1-1959)

Bare Electrical Conductors

Specifications for:

Soft Rectangular and Square Bare Copper Wire for Electrical Conductors (ASTM B 48-58; ASA C7. 9-1959).

Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members for Electrical conductors (ASTM B 172-58; ASA C7. 12-1959).

Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members for Electrical Conductors (ASTM B 173-58; ASA C7. 13-1959).

Bunch-Stranded Copper Conductors for Electrical Conductors (ASTM B 174-58); ASA C7. 14-1959).

Concentric-Lay-Stranded Aluminum Conductors, Hard-Drawn, Three-Quarters Hard-Drawn, and, One-Half Hard-Drawn (ASTM B 231-58; ASA C7. 21-1959).

Concentric-Lay-Stranded Aluminum Conductors, Steel-Reinforced (ACSR) (AS TM B 232-58; ASA C7. 22-1959).

Copper Bus Bar, Rod and Shapes (ASTM B 187-58; ASA C7. 25-1959).

Seamless Copper Bus Pipe and Tube (ASTM B 188-58; ASA C7. 26-1959).

Standard Weight Zinc-Coated (Galvanized) Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR) (ASTM B 245-58; ASA C7. 28-1959).

Zinc-Coated (Galvanized) Steel Core Wire (With Coating Heavier than Standard Weight) for Aluminum Conductors, Steel Reinforced (ACSR) (ASTM B 261-58; ASA C7. 34-1959).

Method of Test for:

Resistivity of Electrical Conductor Materials (ASTM T 193-58; ASA C7. 24-1959).

Dielectric Constant and Dissipation Factor of Expended Cellular Plastics Used for Electrical Insulation (D 1673-59 T)

Frictional Characteristic of Enameled Magnet Wire for Use in Winding Filled Coils (D 1676-59 T)

Recommended Practice for:

Exposure of Polymeric Materials to High Energy Radiation (Jointly with D-20) D 1672-59 T)

Here is the difference between just any reel and MPS reels with
DURA CURL RIMS
Yes, it's the exclusive MPS heavy duty thickened-section rims that assure maximum strength and rigidity throughout the reel heads. Flange run-out and straightening expenses are eliminated by this patented MPS development. DURA-CURL rims are now standard on all MPS wire drawing, annealing, and stranding spools and reels. We invite your inquiries — let us tell you more about Dura-Curl rims.
MPS
trouble-free winding spools and reels
Mossberg PRESSED STEEL Corporation
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DIVISION OF WANSKUCK CO.
No. 107

Inco Filler Wires

The recent introduction of lightweight, compact MIG welding guns has prompted considerable demand on the part of fabricators for small spools of inert-gas welding filler wires. In response to this demand, **The International Nickel Company, Inc.** is now producing a variety of its established filler wires on new two-pound spools that can be attached directly to the MIG gun.

* * *

Capable of joining several Inco Nickel Alloys as well as most dissimilar alloy combinations, the following selection of Inco filler wires is now available on small spools:

Inco-Weld "A" Filler Wire
"67" 70/30 Copper-Nickel Filler Wire
"62" Inconel Filler Wire
"61" Nickel Filler Wire
"60" Monel Filler Wire

* * *

Since the new two-pound spools are designed for direct attachment to the MIG gun, welders can now reach many areas previously considered inaccessible.

New Silicone Rubber Cable Insulation

Availability of a new silicone rubber compound specifically for wire and cable insulation has been announced by **Dow Corning Corporation.** Developed to meet the need for more easily extruded silicone rubber stocks, the new material requires no mill freshening prior to extrusion. Packaging is in hats or strips ready for direct feeding from the shipping container into the extruder.

* * *

Identified as Silastic® 1601, the new material has been designed to meet the requirements of insulation for Underwriters Laboratories Standards for 200 C rated Fixture and Appliance Wire.

* * *

Faster extrusion rates and dense, homogeneous insulating walls without post-cure are other benefits cable manufacturers will derive from this new material. Silastic 1601 maintains its electrical properties at high temperatures and remains flexible at over a wide temperature range, suggesting applications in a wide variety of wire and cable constructions.

High Strength Conductive Cable

"High strength conductive cable is not only practical but in fact is in current production at **Bergen Wire Rope Company," Homer W. Clapper,** president, stated at a recent meeting of airframe manufacturers. The Lodi, New Jersey, firm has developed a special swaged terminal which grips the cable end to full strength, yet permits the electrical conductor to pass through without compression damage. The Sikorsky Aircraft Company, in its S-60 crane helicopter, has found the entire cable assembly very satisfactory. Of 7/8 inch diameter, breaking strength as high as 65,000 pounds has been successfully demonstrated.

* * *

The Bergen terminal design, for which patents are pending, is the only such device which assures to-

Announcement of RATE INCREASE

on advertising in

THE WIRE AND WIRE PRODUCTS BUYERS' GUIDE AND YEARBOOK OF THE WIRE ASSOCIATION

After holding the advertising rates in this highly useful directory for more than 20 years, costs have caught up with us and we are forced to announce an increase for the 1960 Edition.

At the same time, the closing date has been moved ahead one month to February 20 as a convenience to advertisers, and the publication date changed to May 1st.

This directory, the only one published for the Wire Industry, has been issued as a non-profit service to the field. It carries the most complete lists collected in any one publication of bar, rod, wire, wire products, electric wire and cable, and all machinery, equipment and supplies consumed by the industry. The 1959 issue contained approximately 450 pages of data on buying sources and other pertinent industry information.

For a copy of the 1960 rate card, write

WIRE AND WIRE PRODUCTS

453 MAIN ST. **STAMFORD, CONN.**

tal strength plus full conductivity. Other important characteristics of the new cable assembly are its non-rotating feature regardless of degree of load and its hermetically sealed design.

* * *

This new complete approach to conductive cable problems has resulted in a product never before available for hauling, lifting and towing operations, which have long been limited by the lack of high-strength waterproof terminals for conductive cable.

"Rad" To Designate Radiation Unit

The Joint Subcommittee on Radiation Effects of ASTM Committees D-9 on Electrical Insulating Materials and ASTM Committee D-20 on Plastics, has recommended the use of the rad as a national standard unit for reporting radiation dose. The rad, which represents 100 ergs of energy absorbed per gram of material, is independent of the kind of ionizing radiation (X-ray, gamma rays, beta rays, neutrons, etc.), as well as of the type of material being irradiated. In this respect the rad differs from most other units currently in use for measuring radiation intensity and radiation effects. For example, the well-known Roentgen unit applies only to X- and gamma radiation absorbed by air.

* * *

In order to use the Roentgen as a unit for measuring exposure to radiation of materials or tissues other than air it has been found expedient to use a modified unit such as the rep, (Roentgen equivalent physical). The rep was originally defined as the dose of any nuclear or ionizing radiation resulting in the absorption of 93 ergs per gram of tissue. The energy equivalent of the rep has been changed in recent years to 98 ergs per gram because of more accurate measurements.

Second Issue of "Cobalt"

The second issue of the Cobalt Information Center's quarterly, "Cobalt," is now available to interested persons.

Featured in this journal is a technical paper on newly developed cobalt-chromium-iron-base alloys with interesting oxidation, corrosion, and wear-resistant properties. Applications for these alloys in the mining, extractive-metallurgy, heat-treating, and gypsum industries are listed.

* * *

Other articles concern the use of cobalt additions to carbon and alloy steels and cobalt oxides as catalysts for automobile exhaust fumes.

* * *

Requests should be addressed on company letterhead to the Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio. Persons outside the Americas should write to the Centre d'Information du Cobalt, 35, rue des Colonies, Brussels, Belgium.

Get the habit of reading regularly
WIRE AND WIRE PRODUCTS
The Wire Man's Magazine

BUYER'S GUIDE CHANGES

The 1960 Edition of the WIRE AND WIRE PRODUCTS BUYER'S GUIDE is now being edited for changes of address, company names, products, etc.

All manufacturers of rod, wire, bars, wire products, electric wire and cable, and machinery, equipment and supplies used in the wire industry

are INVITED and URGED to send us any changes that should be recorded in our listings. Do it now! Listing changes MUST be in our office by January 20th.

Hundreds of changes have been received already, but many more, we are sure, SHOULD be made. No charge for listings.

We want the BUYER'S GUIDE to be correct. You want your company and products to be properly listed. It helps you and helps the industry to locate products.

May we have your cooperation.

Send changes to

WIRE AND WIRE PRODUCTS
453 Main Street Stamford, Conn.

Adjustable-Speed Drive Booklet

Adjustable-speed and drive control problems are discussed in a new booklet produced by Cleveland Worm Gear's Speed Variator Division. Designated Bulletin No. K-250, the booklet presents eight pages of typical applications along with methods and types of remote and automatic control, plus variable speed bedplate assemblies.

* * *

Available upon request to **The Cleveland Worm & Gear Company,** Speed Variator Division, 3300 East 80th St., Cleveland 4, Ohio.

Atlas Steels Reorganizes Marketing Structure

Atlas Steels Ltd., Welland, Ont., has changed its organizational structure in order to co-ordinate its world wide operations and, hereafter, will operate under a two division plan comprising the Atlas North American and Atlas International Divisions, both reporting to the president of Atlas Steels Ltd. **Arthur C. Rae** has been named vice president-marketing of Atlas Steels and general manager of Atlas International. **F. J. Lockhart,** vice president, Canadian sales, becomes vice president-sales, North American.

* * *

Mr. Rae will direct all sales and manufacturing operations of the company's foreign subsidiaries and associated companies, including Canadian exports previously directed by the Export Division at Welland.

Steel Co. of Canada Plans Expansion

The Steel Company of Canada, Ltd., has announced plans to increase capacity of its Hamilton works by almost 25 per cent in the next two years.

* * *

H. G. Hilton, chairman and chief executive officer, told the company's annual meeting a new 300-ton open hearth furnace, together with improvements and additions to rolling and processing equipment would raise the company's annual ingot capacity from its present 2,350,000 tons to 2,900,000 tons.

* * *

Mr. Hilton said in the last ten years the company has spent well over $200,000,000 on plants and properties. This expansion has provided many new jobs and economies resulting from greater output and more efficient tools.

Important Development for Spring Makers

Sleeper & Hartley, Inc., Worcester, Mass., manufacturers of spring coiling machinery, recently announced the successful development of an automatic looping attachment for their No. 0 Universal Spring Coiler.

* * *

Although the company developed a bed spring coiling and looping combination early in the century, it was not until the Summer of 1958 that Chief Engineer Elmer

WIRE BENDING and FORMING MACHINES

SPECIAL PURPOSE WIRE WORKING MACHINERY

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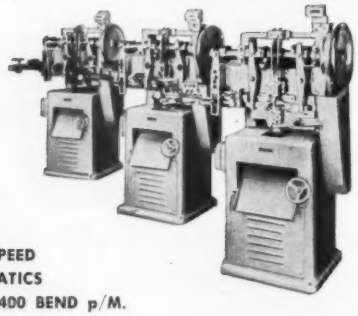
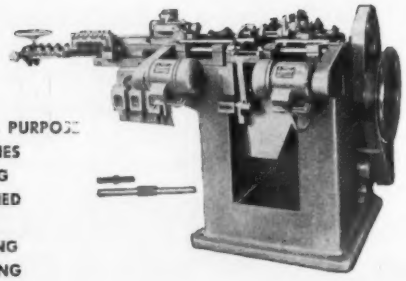


HIGH SPEED AUTOMATICS UP TO 400 BEND p/M.

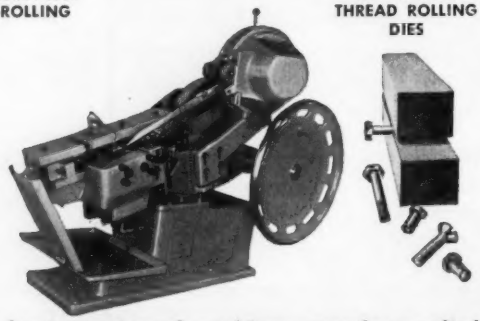


SPECIAL PURPOSE MACHINES BENDING COMBINED WITH STAMPING PUNCHING AND MILLING OPERATIONS

SCREW MAKING MACHINERY

SCREW-HEAD-SLOTTING-COLD-THREAD-ROLLING MACHINES

ALL TYPES OF THREAD ROLLING DIES



Please ask for inspection of machines recently supplied to North American customers.

Please submit samples or drawings of articles you contemplate to manufacture.

SOLE REPRESENTATIVE FOR CANADA

PAUL REICHER MACHINERY & EQUIPMENT LTD.
600 Eglinton Ave. East, Toronto 12, Ont.
(IBM Building)

Ludwig Grefe -- Maschinenfabrik -- Luedenscheid
Western Germany

Halversen tackled the problem for mechanical springs in a new approach that has resulted in a machine that is reported to be doing a better job yet will sell for 40% less than machines designed to loop the spring automatically.

* * *

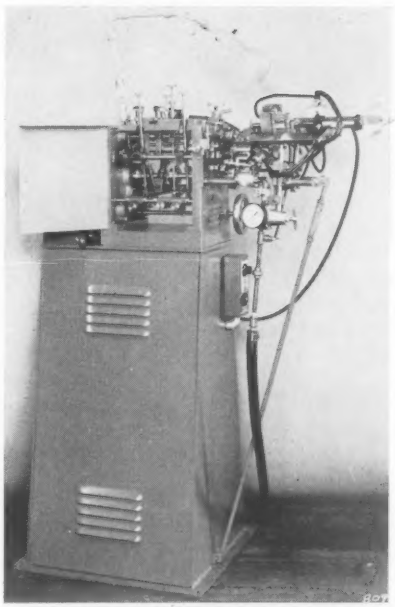
The basis to the approach was simplification. In keeping with this principle, the first loop is made on the universal spring coiler using new motions of the existing cutter shafts.

* * *

A pneumatically operated pick-off, straight-line transfer, and last-end looping mechanism was chosen to perform the more involved secondary motions, the weak point in previous mechanical units. It eliminates the conventional looper which now need be used only for small runs. Loop forming tools are based on those used for years on S&H semi-automatic spring looping machines.

* * *

The unit is capable of handling springs with as few as 3 or 4 coils, making loops of the same diameter as the coil or larger. It has been operated on .010" to .020" wire and can be used on springs having a 1/8" to 3/16" O.D., although the actual range may be greater. Normal production is approximately 50 springs per minute.



S & H Looping Attachment for No. 0 Universal Spring Coiler, Escapement Type. * *

* * *

Full details may be secured from Sleeper & Hartley, Inc., 334 Chandler St., Worcester 1, Mass.

Roebling Announces Name Change

It has been announced that the name of the **John A. Roebling's Sons Corporation** has been changed to **John A. Roebling's Sons Division, The Colorado Fuel & Iron Corporation.** The company formerly operated as a subsidiary of CF&I.

Correction

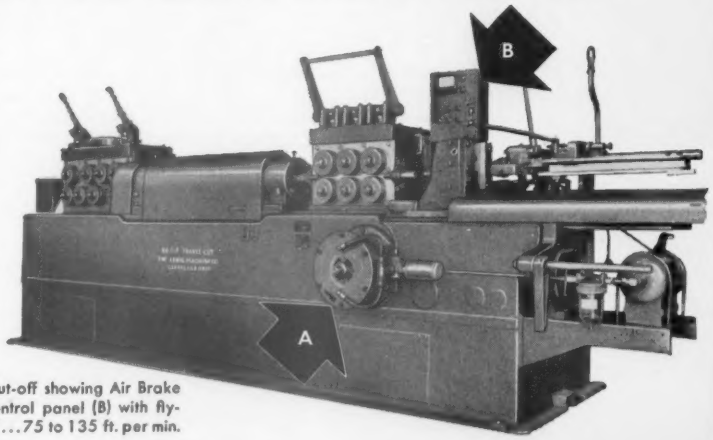
In the August issue of Wire and Wire Products, on page 960 under the article caption "New Extrusion Techniques with Silicone Rubber", the Division of **Union Carbide Corporation** was erronously stated as Union Carbide Plastics Company. Messrs. **H. H. Bashore, E. G. Schwarz** and **C. E. Simpson** are identified with the **Silicones Division** in Tonawanda, New York.

SUPERIOR QUALITY CONTROL!

WITH LEWIS TRAVEL-CUT WIRE STRAIGHTENING AND CUTTING MACHINES EQUIPPED WITH AIR CLUTCH, AIR BRAKE AND VARIABLE SPEED DRIVE

Lewis engineers have added three important improvements to their famous Travel-Cut Wire Straightening and Cutting Machines, 1. Wichita Air Clutch, 2. Wichita Air Brake, 3. Reeves Motodrive or similar variable speed drive, for SUPERIOR QUALITY CONTROL. Assures greater accuracy and produces quality rod with a minimum of spot swell. Lewis Machines are available in 34 models to handle from .012" to ¾" dia. at speeds up to 200 FPM.

NEW BROCHURE ON REQUEST



No. 11-F Travel-Cut with Flying Shear Cut-off showing Air Brake (A) (guard removed) and push-button control panel (B) with flywheel speed tachometer. Cap. ½" to ¾"...75 to 135 ft. per min.

THE LEWIS MACHINE COMPANY 3440 EAST 76th STREET CLEVELAND 27, OHIO

New Automatic Coiling and Looping Machine Announced

A new fully automatic coiling and looping machine has been placed on the market for the Spring manufacturing industry by the **Frank L. Wells Company.**

* * *

Wells has been a manufacturer of wireworking equipment for the bedding industry since 1893. For a number of years it has been building automatic coiling and looping machines for heavy gauge wire in large diameter coils for bed springs, link fabrics, etc.

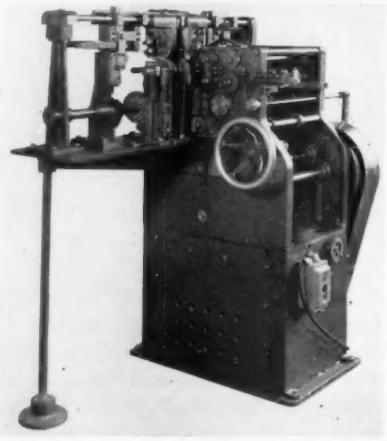
* * *

Because of the spring manufacturing experience of the **Harvey Spring and Manufacturing Co.** of Chicago, the Harvey organization assisted the Wells Company in the engineering and tooling work on the new spring forming machine. Harvey, whose business is the production of close tolerance mechanical springs, has entered into an agreement with Wells to act as sales agents for the new coiler and looper.

Harvey has had the new machine in operation at its plant for several months and has demonstrated it to many interested spring manufacturers.

* * *

The new machine, illustrated, has a capacity to handle .025″ to .062″ diameter wire, with a coil range of 3/16″ o.d. to 5/16″ o.d. and body lengths of from approximately ½ to 5 inches.



This machine automatically coils, trims and loops in sequence. By trimming before looping, extremely accurate springs are produced. Loops made are crossover, machine and side-loop types — or any combination of these. The relationship of the loops on each end can be varied 360° to each other and maintained within ±3°. Openings in loops can be held to ±.010″ or less.

* * *

For further information, please write either The Frank L. Wells Co., 5821 5th Ave., Kenosha, Wisc., or Harvey Spring & Mfg. Co., 871 N. Sangamon St., Chicago, Ill.

New Company Organized To Serve the Wire Industry

M. G. Steele has announced the organization on June 1st of the **M. G. Steele Company,** which will engage in the designing and building of electric brazing equipment, tensile testing machines, and other equipment now in the process of development.

* * *

The new firm, located on Yacht Club Road, Rome, N. Y., will also serve as development engineers and mechanical consultants to the wire industry.

* * *

Mr. Steele had been the head of the mechanical section of **Rome Cable Corporation's** Research Center for the past nine years. A part time association with his former employer will be continued, as he has been retained by them in a consulting capacity.

* * *

An article on page 1096 of the September issue of **Wire and Wire Products** describes a method for joining solid and stranded copper wire without the use of a flux, using silver solder. The equipment described, since modified and improved in efficiency, and with no change in the basic principle, is expected to be commercially available in the near future. It has capacity for wires of No. 16 A W G and larger. A smaller unit (Model M-101) for wires of No. 18 A W G to No. 30 A W G has been marketed by Steele for the past two years and has been well received by the wire industry.

EQUIPMENT

Extruders
Takeup Equipment
Payoff Equipment
Spoolers
Respoolers
Measuring Machines
Capstans
Cable Strippers
Braiding Equipment
Twinners, Stranders, Cablers, Bunchers
Spark Testers
Printing Machines
Spiral Striping Machinery
Taping Equipment
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Wire Drawing Machines
Specially Built Equipment
And Much More

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Bare, Tinned and Silver Plated Copper Wire, Stainless Steel, Silver, Nickel, Bronze, Brass and Other Bare Wires
Numerous Other Items

all the wire industry in the West looks to 2 companies

First, there's Western Wire & Textile Machinery, Inc., the only company in the West that deals exclusively in used and reconditioned wire and cable-making equipment.

Secondly, there's the Paul I. Kenner Co., supplier and distributor of new wire and cable manufacturing machinery and supplies.

Nowhere else in the West will you have a better chance of finding exactly what you need---either new or used. Nowhere else in the West will you be able to trade in old equipment on new. Nowhere in the West will you find such a complete stock of machinery and equipment.

You'll like dealing with men who speak your business language---with companies backed by 20 years of highly specialized experience.

SOME EQUIPMENT ON HAND:

Takeups • Payoffs • Braiders • Asbestos Carding Lines • Taping Machines • 13 Die Copper Rod Breakdown Machine with Cook M-1000 Spooler Takeup.

2 Two companies that provide all that's needed, new and used for the West's wire industry.

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PAUL I. KENNER CO.
228 Shaw Road South San Francisco, Calif. Tel.: JUno 9-1101

Wire Kinks

(*Continued from Page* 1509)

volume of lubricant in the system, so that the equilibrium of the hydrolysis is pushed to yield hydroxyl (alkali ions) faster than carbonation takes place. Frequent checks are therefore necessary.

Some Pointers For Diamond Die Users

Start drawing with good, clean annealed wire as patches of oxide or other imperfectly annealed wire serve to give the dies repeated blows, and diamonds are sensitive to shocks.

* * *

Dies should be freely movable in the holders so as to provide universal adjustment of the die to a holder, allowing the die to be straight from cone to cone, and coaxial with the die bore.

* * *

Start the wire into the die from the entry side. Dies are usually marked with the size and trademark on the entry side.

* * *

Provide adequate circulation of a suitable lubricant for lubrication and cooling.

* * *

Remove die and replace at the first signs of scratching with a fresh die, to avoid wire damage and the die becoming oval and rough.

* * *

Maintain adequate supply of new or resized and polished dies to avoid undue down-time. Spares should be in all gauges.

* * *

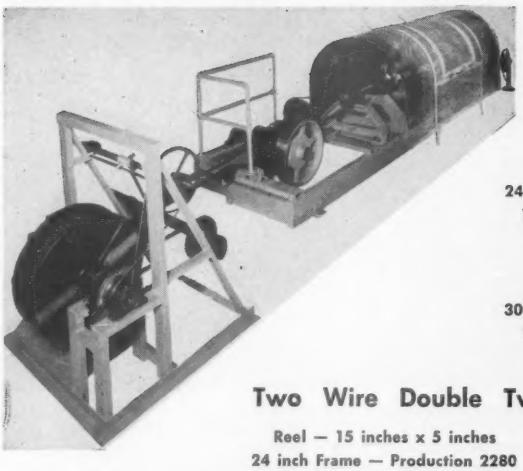
Drawing speeds for diamonds are practically the same as for other die materials. Soft metals can be drawn at higher speeds than hard.

* * *

Use of heavy stones for dies is desirable to allow for maximum recutting and polishing to the next larger size.

* * *

Use dies from stones of uniform size in multiple draft continuous machines. Wire should be kept taut and true between dies, and espe-



TWO WIRE SINGLE TWIST TWINNING MACHINE

— Reel 24 inches x 16 inches
24 inch Frame — Production — 1140
Twists per minute — Power 3 H.P.

•

Reel — 30 inches x 16 inches
30 inch Frame — Production — 1000
Twists per minute — Power 3 H.P.

Two Wire Double Twist Twinning Machine

Reel — 15 inches x 5 inches
24 inch Frame — Production 2280
Twists per minute — Power 3 H.P.

Reel — 24 inches x 12 inches
30 inch Frame — Production 2000
Twists per minute — Power 5 H.P.

All Double Twist Machines are equipped with our Patented Constant Tension Over Run Prevention Devices. Take-Ups are engineered to run with these high speed machines and have tensions which can be quickly adjusted while in operation and Over Run Prevention Devices eliminating wire drawn down on stopping.

All machines have Open Sided Capstans and Quick Loading Cradles for high production and ease of operation.

FOR COMPLETE DETAILS WRITE OF WIRE

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*

SPECIALIZED ENGINEERING
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FOR
TWISTING • STRANDING • BUNCHING
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MACHINE CO., INC.
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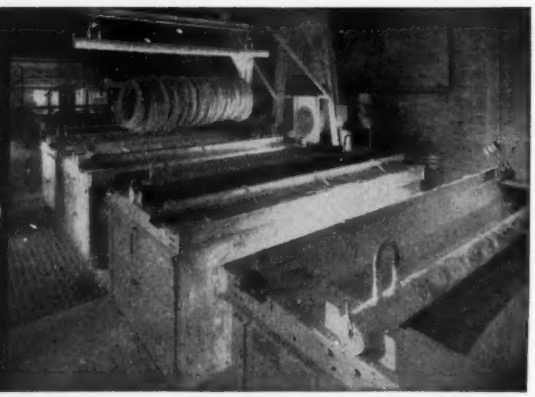
HI-SPEED REGISTERED
ROD BAKERS



Faster baking, greater fuel economy, maximum production efficiency are just a few of the results of the exclusive heating arrangement of the Carl Mayer Hi-Speed Rod Baker. It also has a patented blow-off feature which removes moisture without damage to coils.

Here are just a few of our many satisfied customers:

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Republic Steel Corp.
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Patent Nos.
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2,235,559
Canada 396,144
401,589

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"MINI-MODULE" PRE-FABRICATED STORAGE RACKS
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Easy To Handle • Quickly Set Up Or Taken Down

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Jarke Mini-Modules give you storage when you want it, where you want it. Easily set up or taken down, no bolts, no tools, no fittings. Special "nesting" caps provide fast stacking and insure rigid, no-slip interlocking tiers. Sturdy steel construction. Lightweight. Four standard sizes. Send for details now!

4000 lb. cap. Unit $25.70 each

WIRE COIL RACKS

Designed for stacking coiled material, these racks have four-way entry for fork truck, open ends for ram-type deposit of coils. Nesting caps insure fast easy stacking. Heavy-duty steel construction.

Std. Unit $33.20 each

PORTABLE BAR RACKS

Unique crane grab permits load centering and rapid fool-proof engagement. Automatic grab also available. Assorted standard sizes. Specials to order.

JARKE MANUFACTURING COMPANY
6333 Howard St.
Chicago 48, Illinois

MODULAR STORAGE SYSTEMS FOR METAL INDUSTRY • STEELMOBILE

cially it should enter the first die true, or premature failure may result.

* * *

Handle diamond dies carefully. Do not clamp in a vice or hammer them. Protect against all shocks. Sudden release from tension when a large, hard-metal wire is run right through the dies may cause damage. Machine should be stopped before wire runs out.

Shaving Copper Rod

The finer the gage of copper wire to be drawn, the more important is shaving.

* * *

Hot rolled rod has many surface imperfections, that, although not visible to the naked eye, may cause wire breakage at the high speeds at which fine copper wire is drawn.

* * *

Coils of cleaned rod are first drawn through at least one die, reducing the diameter one or two gage numbers, to make the rod round so that a minimum amount of copper will be lost by the shaving. Rod usually has on its surface slivers and flaws from rolling.

* * *

The rod or wire should then be passed through a guide die to assure concentricity before it enters the shaving head, which trims off .004" to .006" of the surface, depending on the condition of the rod being drawn.

* * *

Shaving of copper rod is a well-established operation, its value having been demonstrated widely in improved wire quality and lowered production costs.

Ring Travelers

Among the many products made from wire are the ring travelers used in the manufacture of textiles. Unlike most products, the process starts with accurately drawn specification wire and the making of the finished product is a series of precision operations.

* * *

Horizontal spinning travelers are made of steel wire, while vertical ring travelers are made of bronze or steel. They come in a great variety of sizes and shapes, depending

on the service for which they are intended.

* * *

The first step is the rolling of the round wire into final shape, i.e., round edge flat wire, half round or oval. At this point the wire is formed into rings on automatic machines. Next, is the carburizing of a soft low carbon wire to impart a hard, wear-resistant surface to the wire. Then the wire is heated to somewhere near the critical point and quenched in water or oil. The steel is now in a hard, brittle martensitic state. The temper is finally drawn by low temperature heat treatment to provide the proper springiness for the rings.

* * *

Finishing steps include polishing in tumbler barrels and rust-proofing to insure the arrival of the rings in perfect condition.

Swiss Welding Machine Exhibited in Paris

H. A. Schlatter A. G., represented in North America by Paul Reicher, 600 Eglington Ave., East, Toronto 12, Ont., Canada, manufacturers of wire mesh welding machines, butt welders and other welding equipment, showed a number of its machines at the 6th European Machine Tool Exhibition in Paris from September 12 to 21, 1959.

* * *

On hand to answer questions and assist visitors with their welding problems were a skilled staff of Schlatter engineers and technicians. Besides equipment for wire, the Swiss concern produces welders for all industrial applications.

You Are Invited To Join

THE WIRE ASSOCIATION

Send for booklet describing its activities and a membership application card.

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CAMDEN WIRE CO., INC.

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Wire Fabricators

PRODUCERS OF QUALITY FINE WIRE COPPER CONDUCTORS

SOLID • BUNCHED • STRANDED OR BRAID

BARE • TIN OR LEAD COATED AND SILVER PLATED

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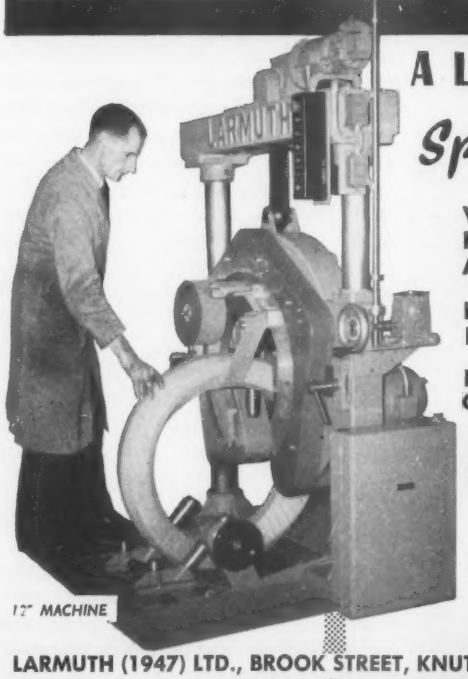
HEAVY COIL WRAPPING MADE EASY WITH LARMUTH'S NEW 12" MACHINE

Now Glues The Paper As It Wraps



12" MACHINE

A LARMUTH *Spiral Wrapping* **MACHINE**

WITH PATENT MECHANICAL LOADING AND EJECTION

FOR COILS UP TO 12" WIDE

PUSH BUTTON CONTROLLED

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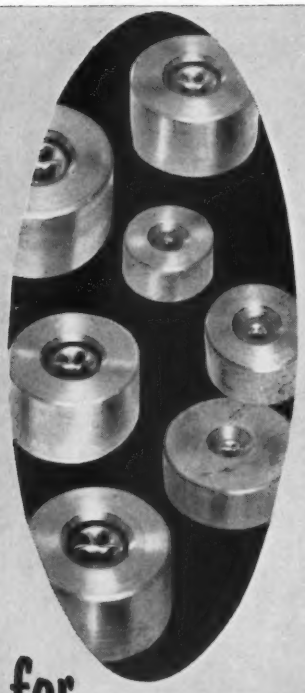

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HYPREZ DIAMOND COMPOUNDS

Our rigid laboratory controls guarantee unfailing uniformity of Hyprez grading and concentration. That's one important reason for Hyprez superior performance—shorter finishing time — longer die life, greater production. Want proof? Ask your nearby Hyprez distributor for a free demonstration.

. . . or write for Technical Bulletin HW-49

HYPREZ DIVISION
ENGIS EQUIPMENT CO.
431 S. Dearborn St., Chicago 5, Illinois

Copper's Future

(*Continued from page* 1503)

come of age, along about the mid-1960's, demand for housing will begin to spurt. The National Association of Home Builders predicts that housing needs will start to rise in earnest after 1966, and that by 1980, some 2 million new homes a year will be needed just to keep pace with population growth. Although copper may have been displaced in some uses connected with building construction, in others, for example, the new series of DWV tube, designed especially for soil, waste and vent lines, copper has gained ground. The London Economist has suggested an annual increase of 8% as a guide to the world's building requirements. Copper needs in this industry may be expected to rise to 630,000 short tons by 1965.

* * *

Having now surveyed the anticipated requirements of the major copper users—the electrical industry, shipbuilding, motor vehicles and building construction—what can we say of the expectations for the remaining outlets? In the aircraft industry, over-all requirements have tended to decline as military emphasis has shifted from manned aircraft to missiles. However, the likelihood is that electronic and electrical systems in the more advanced aircraft will expand, with some industry spokesmen predicting as much as a ten-fold gain in copper usage per plane. As in the case of manned aircraft, missiles and rockets will continue to be sizeable users of copper, principally in the form of wire. The Atlas missile, for instance, requires 180,000 feet of copper wire. While copper usage on a unit basis is not likely to rise much above present levels, the prospect of increasing emphasis upon space exploration and development gives indication of mounting over-all demand in this field.

* * *

New developments in railroading, as for example the new copper alloy journal box unit for freight cars, suggest the possibility that railway requirements for copper may experience a dramatic rise. The outlook for appliances, which is tied to what economists call the "life cycle," seems almost certain to be an expanding one, with the next big wave of expansion due to come with the "war baby" family formations of the mid-60's. Another prospect which seems likely to accelerate copper demand is the world's growing thirst for water. Per capita requirements for water in the United States have nearly tripled in the past 50 years, due largely to industrial growth. Various models for the economic production of fresh water from saline or salt water promise an abundant use of copper. To the areas just cited must be added the possibility of increased copper requirements in other fields, such as those of machinery and equipment, coins, scientific instruments, utensils and jewelry.

* * *

These attempts at prognostication add up to a possible need for 5.1 million short tons of copper by the year 1965, representing an increase of more than 45% above the level of 1958 requirements.

* * *

The indicated demand for 1965 is apportioned among the consuming industries on an order of magnitude about like this—

Estimated Copper Needs for 1965 ('000 tons)	
Electrical Industry	2,500
Shipbuilding	1,000
Motor Vehicles	500
Building Construction	630
Other Users	470

* * *

From all that I have said you may conclude, and rightly, that copper's future is bright. With world population growing at the rate of 45 million per year, with industrialization expanding throughout the world, and with over-all demand for copper and copper alloys mounting as a corollary to world economic progress, the prospects for the industry over the years to 1965 are encouraging.

* * *

More that that, copper's future is likely to be even brighter in the period following 1965, when family formations, it appears, will begin to spurt, thereby setting in motion

CUT
Die Room
COSTS
50%
with the New
type "M"

DYKREX
"IT CORRECTS THE DIE"

automatic
Polishing Machine

Double your finished Tungsten Carbide Die production

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Save 1/2 labor costs—

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The new automatic polisher with the Time Switch—

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It is completely assembled—just plug it in!

ROOS TOOL & MFG. DIVISION
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Phone: PIlgrim 4-1500

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Jefferson, Mass.
Western Union
Teletype Service
QAB-FAX—Montclair, N. J.

The Standard of the Wire Industry

accelerating demands for housing, motor vehicles, appliances, telephones and other appurtenances of modern family living.

* * *

The opportunities confronting the industry are not without their sobering aspect, however. For such opportunities will invite competition, competition even more strenuous than we have witnessed in the past. Copper's future, therefore, will depend ultimately on how well all of us in the industry meet the challenges implicit in the new economic era now dawning.

Drawing Titanium and Zirconium Wire

(*Continued from page* 1505)

as fast as stainless steel — i.e., 200 to 300 feet per minute.

* * *

Our goal is to reduce the cost of producing titanium and zirconium wire to the point where they will be competitive with better-known materials on a cost-performance basis.

Folder on Instrumentation for Cable Makers

Addison Electric Co. Ltd., London, W 10, England, has issued a folder describing its complete line of equipment for electric wire and cable manufacturers, that are used throughout the world.

* * *

The line is comprised of wire preheating units, temperature controls, tension meters, optical diameter scanners, calliper gauges for operation under water following the extruder, capitance monitors and controllers, contact diameter controls; eccentricity monitors and controllers, H. F. spark testers, corona test sets, H. V. testing equipment, impregnation recorders, and an analogue computor for cable problems.

* * *

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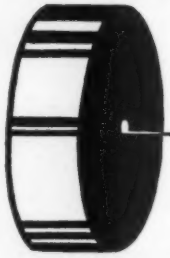

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(*Continued from page* 1485)

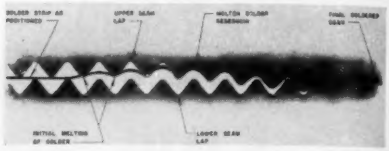

Figure 6

usual alcohol rosin flux on the sheet edges and the solder strip left sticky residues on the forming machine belts, guides and strip inserter to impede the performance of these units. The excess flux liquid would also soak into the core and appreciably increase the necessary heat input in order to vaporize the flux solvent.

* * *

A precision-rolled rosin-cored strip was developed to replace the solid solder strip and liquid flux. It eliminated the flux residue problems. This material enables us to apply a predetermined, uniform, continuous volume of flux in relation to the solder volume and cable length to effect a better joint. The dimensions of the solder strip must be accurately maintained to apply the desired solder volume per unit length of cable and to permit uninterrupted feed through the inserting device. The strip should also be straight and free of cast. The rolled solder strip was not commercially available and the Nassau Smelting and Refining Company undertook the manufacture of this item to our requirements.

* * *

The rosin-cored solder strips have been made in many alloy compositions. It was found that the more fluid tin-lead alloys as the eutectic, 60-40, 50-50, and 40-60, drained out of the sheath seam during soldering. No appreciable reduction of the soldering heat resulted from the higher tin alloys. The 5-95, 10-90, 20-80 tin-lead and electroplated tin coated lead strips were also fabricated and tried. A good soldered joint was made from these. However, the higher soldering temperatures, the lower spread and wetting, and the rosin charring associated with these materials were too critical and difficult for

shop manufacturing practice. The higher lead alloy of 30 tin-70 lead was chosen for its long plastic range to minimize the tendency of the molten solder to drain out of the steel covering seam during the soldering operation. Sufficient eutectic to quickly bond the joining steel surfaces was needed without too much fluidity of the molten solder which would allow it to drain out of the seam by gravity before it was frozen in the joint. The lower tin content of this alloy is also desirable for economic and strategic material considerations. The soldering heat of about 600°F is adequate to liquefy this alloy and not burn off the solderable tin and terne coatings on the steel strip.

* * *

A rosin content of 1.0 per cent by weight was selected in order to have a minimum positive flux content for all conditions and to eliminate the rosin residue gobs which build up on the steel covering with the higher rosin contents. These gobs entrain water which will cause bubbles in the polyethylene jacket when the water flashes into steam during the plastic extrusion operation.

Solder Requirements

The solder alloy corresponds to the trade designation of ASTM alloy, grade 30B. A minimum content of .2 per cent antimony bismuth is recommended to prevent transformation of the tin into the gray form under severe low temperature conditions. The impurity content of copper, antimony, and bismuth is consistent with commecial refining practice for secondary tin, lead, and their alloys. More iron than listed will increase oxidation during the pouring of the solder pigs. Additional zinc and aluminum, more than specified, causes veils and stringy appearing joints. Excessive arsenic promotes dewetting.

Packaging

The rolled solder strip is wound on the cardboard spools shown in Fig. 7. Each pad holds about 22 net pounds of solder strip in one length of about 2,100 feet. Two pads with round cardboard spacers

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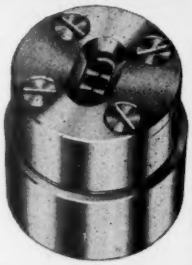

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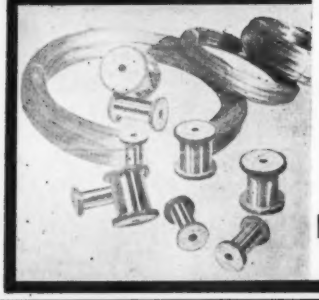

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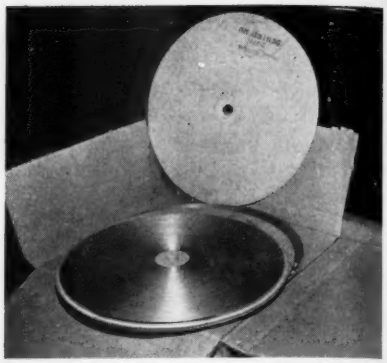

Figure 7 • • • • • • • • • • •

are packaged in each cardboard carton.

Sizes

Solder strip sizes from about .009 inch to .013 inch in thickness and about .25 inch in width are used for the cable core diameter range of .40 inch to 2.38 inches.

ABC of Better Lubrication and Cooling in Steel Wire Drawing

(*Continued from page* 1489)

from economic considerations, there is a limit to the amount of coolant that any one cooling system can put to good use. There is evidence that this limit has been reached with present-day air blast systems.

* * *

The lesson of all this is, I think, that we need more efficiency in the system, and not more coolant. To meet this need, we have initiated research on the fundamentals of coolant flow and heat transfer, by means of models of wire drawing blocks and an experimental high-speed machine. So far, the experimental work has been concerned mainly with internal water cooling. The full details of the analysis and appraisal of various internal block cooling systems will shortly be published. Meanwhile, our conclusions are, broadly:—

1. The superiority of water over air as coolant outweighs the disadvantage of having to prevent rusting and hard deposits on the block cooling surfaces.

2. The latter is best achieved by a closed circuit fed with town's water and by pretreating the cooling surfaces against rust.

3. The block should be thin walled; internal fins do more harm than good.

* * *

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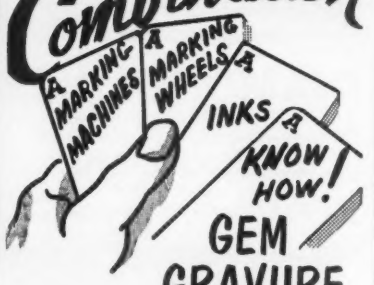

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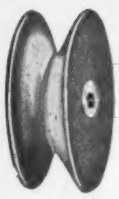

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As a result of these investigations a new block design and internal water cooling system has been invented, combining maximum cooling efficiency with low water consumption, and is at present under development. The indications are that, used in conjunction with an efficient external air cooling system, it will allow drawing speeds to be increased, by as much as 50% in some circumstances, without a corresponding increase of wire temperature.

* * *

Summing up, the way to improve cooling is by the more efficient use of a limited amount of coolant rather than by expending more coolant wastefully, as is done at present.

Acknowledgments

The information contained in this paper is drawn from investigations by the BISRA Wire Drawing Research Ream, and, in particular, by **Mr. A. E. Ranger, G. McH. Sturgeon, G. H. Tattersall** on lubrication, and by **G. D. Spenceley** and **C. F. R. Bradshaw** on wire cooling. These investigations, extending over a number of years, have been sponsored by the Institute of Steel Wire Manufacturers of Great Britain, and guided by the Wire Drawing Committee of B.I.S.R.A. under the Chairmanship of Commander **G. K. Rylands**, O.B.E.

* * *

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Applications of Photoelastic Coatings To Measurements in Wire Manufacture

(*Continued from page* 1491)

which case it serves two simultaneous purposes by measuring twist and pull. Such measurements show the stiffening of cable under increasing load (elongation vs. force) as well as the distortion.

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Recent Developments in Aluminum Alloy Wire

(*Continued from page* 1517)

stranded aluminum conductor, A.C.S.R., and conductor fittings such as joints, dead-ends and jumpers under actual load conditions. Fifty-foot specimens can be tested up to a breaking strength of 200,000 lbs. This equipment is also employed for ascertaining the stress strain relationship of conductors. (Figure XVII).

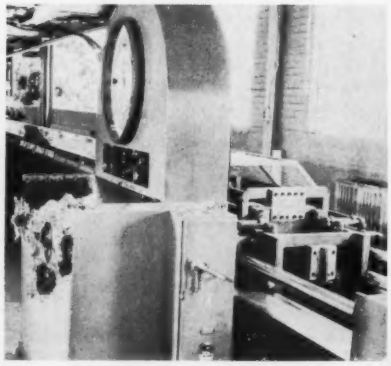

Figure XVII — Conductor and Conductor Accessory Testing Machine

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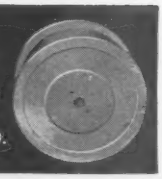
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(*Continued from page* 1513)

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REFERENCES

(1) "Dry Blending for the Vinyl Extrusion Industry" — M. G. Caine Wire & Wire Products — October 1952.

(2) "Vinyl Plasticizer Development" — R. G. Kodesch Modern Plastics — May 1959.

(3) "Some Aspects of the Stabilization of Vinyl Insulation" — J. G. Hendricks and N. L. Cooperman. Plastics Technology — February 1958.

(4) "Spectrographic Analysis of Stabilizers and Fillers in Polyvinyl Chloride Wire Insulating and Jacketing Compounds." — W. J. Bennett. Presented before American Association of Spectrographers Annual Convention — May 1955.

(5) "Infrared Spectrometric Analysis of Polyvinyl Chloride Compounds" — R. A. Burley and W. J. Bennett. Presented before 5th Ottawa Symposium in Applied Spectroscopy — Sept. 1958.

Erratum

In the news item on page 1033 of our August issue, concerning the fact that Frederick Smith & Co. Wire Manufacturers Ltd. has reached its hundredth anniversary, a typographical error as to a date appeared. The fifth line of the second paragraph mentions the year "1950". This should, of course, have been "1850", and we trust that the context made this evident.

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ABSTRACTS

PRODUCTION PROBLEMS IN DRILLING SMALL HOLES.

Fertigungsprobleme fuer Kleinbohrungen.

G. Barna. Fertigungstechnik & Betrieb 1959 Vol 9 (6) pp 325-331 (June) (In German)

The theory of fine drilling techniques is briefly examined, with regard to the relationship between drilling conditions and workpiece size. Five methods of drilling are discussed in detail: with the method commonly used up till now, with an abrasive, by plastic deformation, by electrolytic methods and chemical heat effect, and by electro-erosion. The method used for drilling drawing die diamonds is the electric or chemical heat method. In the heat method the hole through the diamond is produced with the help of acid which burns into the crystal. A V2A-steel box serves as an oven, with a double-walled quartz-glass lining containing molybdenum heating wires. The diamond is clamped on a sintered aluminium shank projecting from the bottom of the oven. The process can be watched through quartz glass windows. The 'boring tool' is a quartz glass spray which ejects acid on the diamond through a 0.1 to 0.35 mm diameter opening. The distance between the spray and the diamond surface to be worked is a few tenths of a mm. During the process hydrogen is brought to the diamond through a porous aluminium tube. A temperature of 900 deg C is reached after about one minute from the positioning of the diamond and the release of hydrogen, and the acid can then be released to burn the diamond.

In the electrolytic method the diamond is set in a small bowl, which is filled with just enough of the electrolyte to cover its surface. The tool is a platinum or platinum-iridium needle, which rests with a constant very light pressure on the working spot. The needle, being an electrode, is shut off from the current at one pole, while the other electrode does not actually touch the workpiece, but is dipped into the electrolyte a little away from it. The current released to cause the erosive process to begin is usually of 60 v. 13 illustr, 10 ref, 1 table.

* * *

USP 2,866,364 (May 8, 1953)
P. Bieberich

WIRE DRAWING DIE BLANK AND METHOD OF MAKING SAME.

The diamond die blank is set inside a ring in a soft aluminium receptacle with a depression in the bottom of the receptacle for the blank, and with a thin cylindrical wall which is folded inwardly and pressed downwardly by a punch so as to force the metal into intimate contact with the diamond and the ring holding the receptacle. Diamonds mounted in this way will seldom break during drilling and usually do not shift from their central position in the holder. The arrangement is illustrated in Fig .... Diamond 12 is set in receptacle 13 in ring 9 under punch 5. The drilled diamond still in the holding ring 9 is shown in Fig .... (8 claims, 4 illustr). Ref cited: 15 USP; 2 FP.

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GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Pittsburgh Carbide Die Co., Monongahele, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
Amchem Products Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INKS—Printing, for Insulated Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

INSULATING MATERIALS—
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
General Tire & Rubber Company, The, Akron, Ohio.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, Naugatuck, Conn.

LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Takemura & Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Bobbin Winders
Hanson & Edwards, Ltd., Warrington, England
Larmuth and Bulmer, Limited, Manchester, England

MACHINERY—Bolt, Rivet, Screw, etc.
Boltmaster Co., The, Cleveland, Ohio
National Machinery Co., Tiffin, Ohio
Takemura & Co., Ltd., New York, N. Y.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Braiding
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)

MACHINERY—Centerless Grinding & Polishing
American Laubscher Corporation, New York, N. Y.

MACHINERY—Chain Link Fence
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Steel & Wire Machinery Co., Cleveland, Ohio

MACHINERY—Chain Making
Larmuth and Bulmer, Limited, Manchester, England
Pan American Supply Company, New York, N. Y.
Steel & Wire Machinery Co., Cleveland, Ohio
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Closing Cable
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N.J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Cold Heading
Boltmaster Co., The, Cleveland, Ohio
National Machinery Co., Tiffin, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn, Maschinenfabrik, Herborn, Germany
Morgardshammars Mek Verkstads A. B., Morgardshammar, Sweden
National Mach'y Exch (Used), New York
Showa Machine Works, Ltd., Osaka, Japan
Steel & Wire Machinery Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Pan American Supply Company, New York, N. Y.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Dead Block (Stationary Coiler)
Morgan Construction Company, Worcester, Mass.
Wells Company, Frank L., Kenosha, Wisc.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Maschinenfabrik, Herborn, Germany
Pangborn Corporation, Hagerstown, Md.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Diameter Control
Daystrom-Weston, Industrial Gauges, West Englewood, N. J.

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Sjogren Tool & Machine Co., Auburn, Mass.
Wayne Wire Die Co., Linden, N. J.

MACHINERY—Draw Benches
American Laubscher Corporation, New York, N. Y.
General Machine Tool Co., Worcester, Mass.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Wire Machinery Inc., Chicago, Ill.

MACHINERY—Edging (See MACHINERY—Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Co., Wallingford, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Extruding
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Royle, John, & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Wafios Machinery Corp., Hackensask, N. J.

MACHINERY—Flat Wire
General Machine Tool Co., Worcester, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Stanat Manufacturing Co., Inc., Westbury, L. I., N. Y.
Steel Equipment Company, Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming Wire
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Galvanizing Wire
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Steel & Wire Machinery Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Insulation Testing (See MACHINERY—Spark Testing)

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia, Pa.
Cook Mfg. Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
EVG., Machinen & Stahl, A. G., Zurich, Switzerland

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Diam., Insulated Wire
Daystrom-Weston, Industrial Gauges, West Englewood, N. J.

MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wisc.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providene, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Co., Tiffin, Ohio
National Mach'y Exch. (Used), New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Packaging Wire
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Paper Clips
Pan American Supply Company, New York, N. Y.

MACHINERY—Patenting Wire
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Pin Making
Takemura & Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensask, N. J.

MACHINERY—Plating
Bartell Machine Tool Corp., Rome, N. Y.
Hodge Bros. Machine Shop, Ossining, N. Y.
Universal Industries Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Printing on Electric Wire
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

MACHINERY—Re-Spooling
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Machine Tool Co., Worcester, Mass.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
National Mach'y Exch. (Used), New York, N. Y.
Vaughn Machinery Co., Cuyahoga Fall, Ohio
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Ring Forming
Pan American Supply Company, New York, N. Y.

MACHINERY—Rod Mill
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Slitting Mills
Steel Equipment Company, Cleveland, Ohio

MACHINERY—Spark Testing
Davis Electric Co., Wallingford, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Peschel Electronics, Inc., Patterson, N. Y.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Special
General Machine Tool Co., Worcester, Mass.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells Company, Frank L., Kenosha, Wisc.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Staple Making
Pan American Supply Company, New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Straightening & Cutting
American Laubscher Corporation, New York, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Patterson, George C. Machine Co., Cleveland Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wells Company, Frank L., Kenosha, Wisc.

MACHINERY—Stranding
Bartell Machine Tool Corp., Rome, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Krupp, Fried., Machinen-Und Stahlbau Rheinhausen, Germany
Larmuth & Bulmer Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Swaging
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth & Bulmer Limited, Manchester, England
Litzler, C. A., Co., Inc., Cleveland, Ohio
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine) France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Thread Rolling
Boltmaster Co., Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cook Manufacturing Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.

Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cock Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Welded Wire Mesh
EVG, Maschinen and Stahl, A.G., Zurich, Switzerland
Schlatter, Ltd., H. A., Zollikon/Zurich

MACHINERY—Wire Weaving
Takemura & Co., Ltd., New York, N. Y.

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery—Welding Wire Fabrics)

MACHINERY—Winding Wire
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Machine Tool Co., Worcester, Mass.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Laubscher Corporation, New York, N. Y.
Atlas Polar Co., Ltd., Toronto, Ont., Canada
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Morgan Construction Co., Worcester, Mass.
Morgardshammars Mek Verkstads AB, Morgardshammar, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Showa Machine Works Ltd., Osaka, Japan
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Wire and Machinery Co., Cleveland, Ohio
Superior Tool & Machinery Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Takemura Co., Ltd., New York, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wire Machinery Inc., Chicago, Ill.

MACHINERY—Wire Forming
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Takemura Co., Ltd., New York, N. Y.

MACHINERY—Wire Rope
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
American Laubscher Corp., New York, N. Y.
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Company, Boston, Mass.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio

NAIL TOOLING—Tungsten Carbide
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Central Tool and Machine Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Michigan Oven Company, Detroit, Mich.

OVENS—Rod Bakers
Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

PAILS—Packaging
(See Drums—Wire Packaging)

PAINT BONDING CHEMICAL
Amchem Products, Inc., Ambler, Pa.

PAINTS—Heat Resisting
Amchem Products, Inc., Ambler, Pa.

PAPER—Insulating
Twitchell, Inc., E. W., Philadelphia, Pa.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PLASTICIZERS—
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

PLASTICS—for Wire Insulation
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, Naugatuck, Conn.

PRINTING WHEELS—for Electric Wire
Daniels & Co., Frank, New York, N. Y.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., Inc., West Hanover, Mass.
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

RACKS—Wire Storage
Jarke Manufacturing Co., Chicago, Illinois

REEL AND TENSION STANDS—
Mettler Machine Tool, Inc., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett ,Ind.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Berger Div., Canton, Ohio
Wood's Sons Company, T. B., Chambersburg, Pa.

REELS—Metal Bound
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.

REELS—Plywood
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
New York Engineering Corp., Yonkers, N. Y.
Republic Steel Corp., Berger Div., Canton, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Steel, for Rope and Cable
New York Engineering Corp., Yonkers, N. Y.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Nelson Co., The, Baltimore, Md.
Republic Steel Corp., Berger Div., Canton, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Woodcraft Company, Bay City, Michigan

REELS & SPOOLS—Wood
American Woodworking Co., Montello, Wisc.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Nelson Co., The, Baltimore, Md.
Woodcraft Company, Bay City, Michigan

REFRACTIONS—High Temperature
Norton Company, Worcester, Mass.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Niederrheinische Huette, A. G., Duisburg, Germany
Pittsburgh Steel Co., Pittsburgh, Pa.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

ROLLS—For Flattening Wire
General Machine Tool Co., Worcester, Mass.

ROPE—Wire
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons, Div. Colorado Fuel & Iron Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—
(See COMPOUNDS—RUST Removing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

SATURATION SYSTEMS—
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—Plastic
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

STOCK STORAGE SYSTEMS
Jarke Manufacturing Co., Chicago, Illinois

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div. Colorado Fuel & Iron Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, Ohio

TANKS—Ceramic, for Galvanizing
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, W.-Germany)

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TENSION METERS—for Wire
Boulin Instrument Corporation, Pelham, N. Y.

TESTERS—INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT — Dielectric Faults in Insulation
Peschel Electronics, Inc., Patterson, N. Y.

TESTING EQUIPMENT — Physical
Scott Testers, Inc., Providence, R. I.

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

TRANSMISSIONS—Variable speed (See Adjustible Speed Drives)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Hodge Bros. Machine Shop, Ossining, N. Y.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VARNISHES & LACQUERS—for Electric Wire
General Electric Company, Insulating Materials Section, Schenectady, N. Y.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

WAXES—for Insulated Wire
Cary Chemicals, Inc., New Brunswick, N. J.

WELDERS—Spot and Butt and Welding Wire Fabrics
Eisler Engineering Corp., Newark, N. J.
EVG, Maschinen and Stahl, A.G., Zurich, Switzerland
Micro Products Co., Chicago, Ill.
H. A. Schlatter, Ltd., Zollikon-Zurich

WHEELS—for Printing on Electric Wire
Daniels & Co., Frank, New York, N. Y.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M., Co., Inc., West Boylston, Mass.

WIRE—Aluminum
Malin & Co., The, Cleveland, Ohio
Scovill Mfg Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Ball
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Malin & Co., The, Cleveland, Ohio
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Bunched and Stranded
Camden Wire Company, Camden, N. Y.

WIRE—Cadmium
Stamford Processing Co., Peekskill, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Copper
Camden Wire Company, Camden, N. Y.
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

WIRE—For Electrical Conductors
Camden Wire Company, Camden, N. Y.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Flat
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Jones & Laughlin Steel Corp, Stainless and Strip Div., Detroit, Mich.
Montgomery Co., The, Windsor Locks, Conn.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado, Fuel & Iron Corp., New York, N. Y.

WIRE—High Carbon
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Detroit Steel Corporation, Detroit, Mich.
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Manufacturers
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Marathon Specialty Steels, Inc., New York, N. Y.
National Lock Washer Company, The, Newark, N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Berger Div., Canton, Ohio
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Metalizing
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Platt Bros & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio

WIRE—Needle
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Alloy
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

WIRE—Oil Tempered
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Special Shapes
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
National Lock Washer Company, The, Newark, N. J.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Spring
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Marathon Specialty Steels, Inc., New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Stainless Steel
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Malin & Co., The, Cleveland, Ohio
National Lock Washer Company, The, Newark, N. J.
Nippon Stainless Steel Wire Mfg. Co., Ltd., Osaka, Japan
Pittsburgh Steel Co., Pittsburgh, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Steel—Also Coppered and Galvanized Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh. Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

YARNS—Wire Insulating
Synthetic Thread Co., Bethlehem, Pa.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE
AND MASTICATING MACHINERY MANUFACTURERS

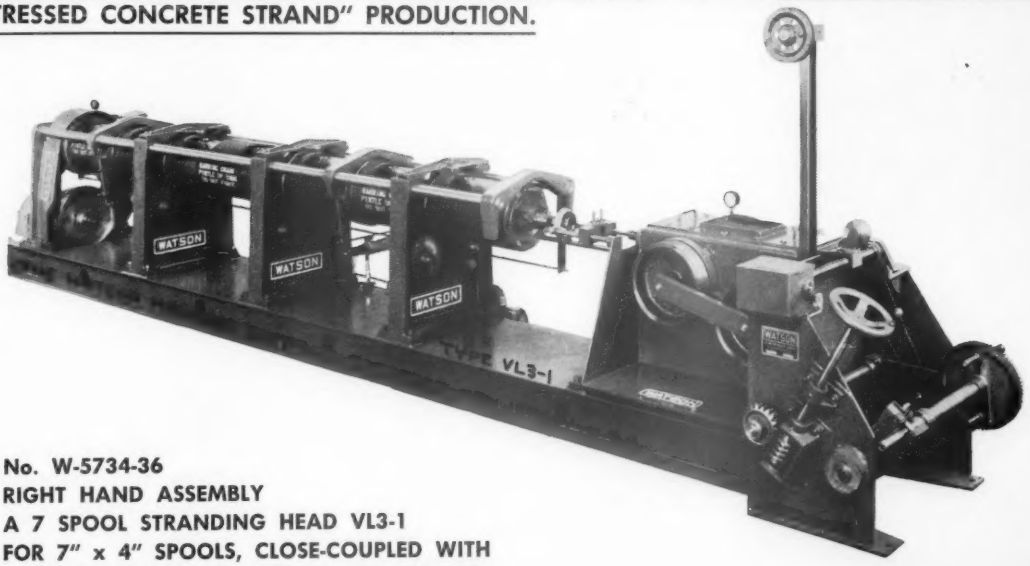
WATSON

EXTRA HIGH SPEED STRANDERS TYPE "VL"

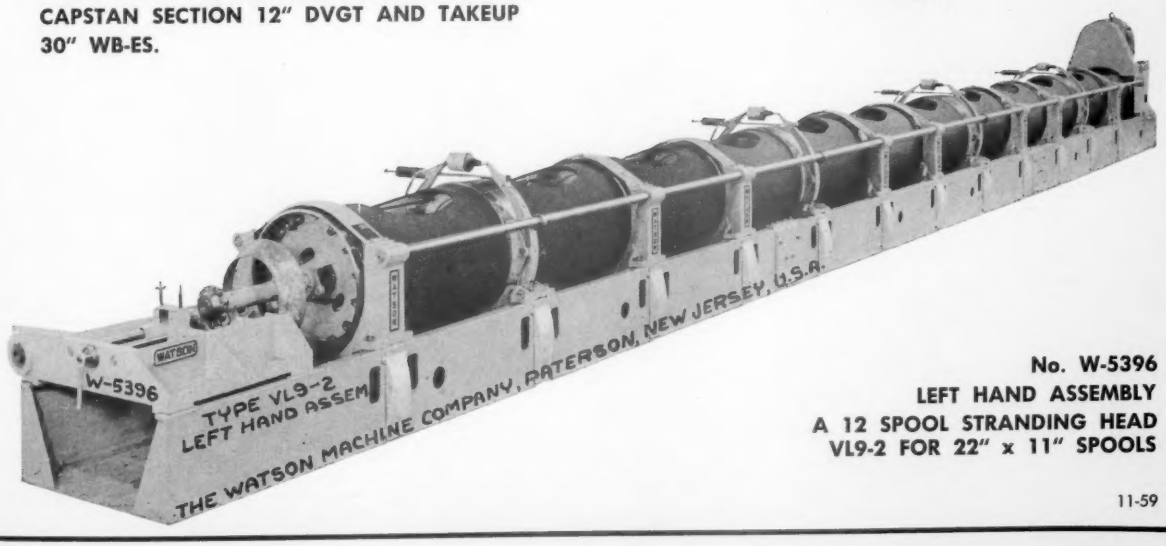
U. S. PATENTS 2,442,817 & 2,690,642

THESE MACHINES ARE BREAKING PREVIOUS PRODUCTION RECORDS AND THEIR QUIET, "HIGH SPEED WITH SAFETY" PERFORMANCE HAS SET NEW STANDARDS WHEREVER THEY OPERATE.

AVAILABLE IN MANY SIZES FOR SPOOLS FROM 3-3/4" DIAMETER (5 POUND) TO 30" DIAMETER (2,000 POUND), THE LARGER UNITS BEING PARTICULARLY SUITED FOR "PRESTRESSED CONCRETE STRAND" PRODUCTION.



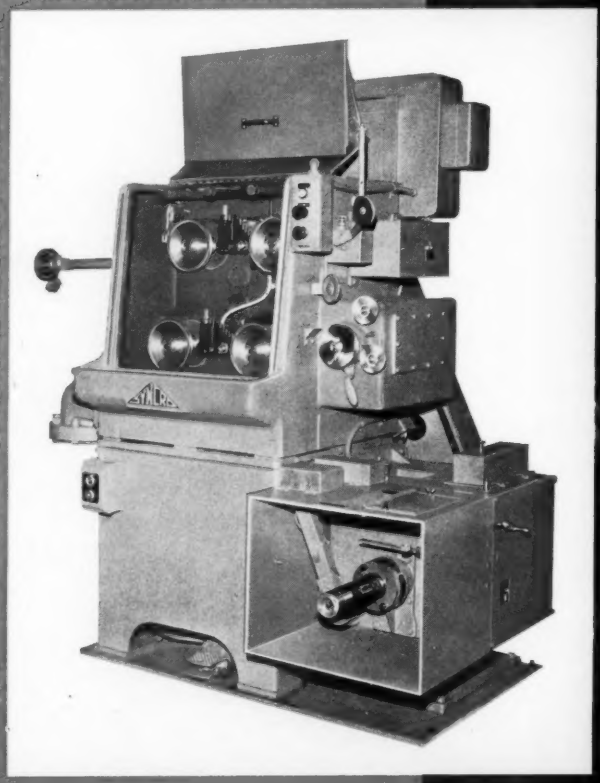
No. W-5734-36
RIGHT HAND ASSEMBLY
A 7 SPOOL STRANDING HEAD VL3-1
FOR 7" x 4" SPOOLS, CLOSE-COUPLED WITH
CAPSTAN SECTION 12" DVGT AND TAKEUP
30" WB-ES.



No. W-5396
LEFT HAND ASSEMBLY
A 12 SPOOL STRANDING HEAD
VL9-2 FOR 22" x 11" SPOOLS

11-59

6000 F.P.M. ...wire drawing machine



Model BG-16 . . . A new measure of Syncro Machine Company's superior design. BG-16 is a 25-horsepower non-ferrous wire drawing machine offering a finished range of copper wire sizes from 19 to 34 B&S gauge, and operating speeds up to 6000 F.P.M. This machine can be supplied with a standard 100 pound capacity model B Spooler (as shown) or larger spoolers to meet specific production requirements. Improved die holders with new reciprocating mechanisms are individually piped to receive solution from the main source of supply. In addition to high speed and heavier capacity, the new all-gear-drive unit incorporates an externally-mounted force-feed lubrication pump with a safety interlock. This pace setting machine serves as another reason why—when drawing wire—it pays to specify Syncro.

THE MEASURE OF SUPERIOR DESIGN

THE MARK OF QUALITY

SYNCRO

SYNCRO MACHINE COMP

Perth Amboy, New Jersey, U.S.A.

affiliated company: WINGET SYNCRO Ltd. Rochester, Kent, Engl

Better Machinery for the Wire Indust

WIRE DRAWING MACHINES • STRANDERS • CONTINUOUS ELECTRIC ANNEALERS • PAYOFFS • CAPSTANS • WIRE INSULATORS • HEAVY DUTY TAKEUPS • TAPERS • SPECIAL